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WATERHOUSE (W. L.). **Studies in the physiology of parasitism. VII. Infection of Berberis vulgaris by sporidia of Puccinia graminis.**—*Ann. of Bot.*, xxxv, 140, pp. 557–564, 19 figs., 1921.

The author's investigations to determine the mode of entry into the host-plant of the sporidia of *Puccinia graminis* Pers. have led him to the conclusion—already arrived at by other workers in the same laboratory in the case of *Botrytis cinerea* and *Colletotrichum lindemuthianum*—that the means employed by the parasite for this penetration is mechanical pressure exerted by the germ-tube, and not, as previously held, the dissolving action of the fungus on the cuticle of the host. It was found that germinating sporidia of *P. graminis* adhered readily to the slide, and could be stained, washed, &c., without loss. The writer ascribes this adhesion to the fact that the germ-tubes possess a mucilaginous sheath, which stains faintly with dilute aqueous gentian violet, similar to that of *Botrytis cinerea*, the outline of the sheath being emphasized by aggregations of particles which are found at a distance from the main wall of the germ-tube.

The germ-tube may elongate considerably and become septate (in one case observed it attained a length of over 1 mm.), the production of long tubes being most frequent when the sporidia germinate in water. Frequently, after a slight elongation, the germ-tube swells into a vesicle, which, in some cases, is large and in contact with the glass slide, being thus of the nature of an appressorium. This also is surrounded, at times, by a mucilaginous investment. The production of these vesicles, which may give rise to secondary germ-tubes, is more common in nutrient media than in water. On the leaf, germination may be marked by the production of a definite germ-tube, which either develops quickly into a vesicle, or may grow on for some distance and even ramify before it becomes closely adpressed to the surface. In other cases no definite germ-tube is produced, but a short beak-like hypha arises directly from the end of the sporidium, pressing down on, and sometimes slightly indenting, the surface of the cuticle. Actual penetration is by a very fine style-like branch which arises either from the end of the germ-tube, when there is one, or from the

short beak at the end of the sporidium, when no germ-tube is formed. This branch penetrates through the outer wall of the epidermal cell in about twenty hours. After entry into the cell it immediately swells into an elongated vesicle, which branches and gives rise to the uninucleated mycelium that invades the tissues of the host. At the moment of entry there is no alteration in the nuclei of the epidermal cell or in the cellulose layers underlying the cuticle. On the upper surface of the barberry leaf, where no stomata are present, entrance into the host always occurs by puncture of the cuticle, the necessary leverage being obtained by the close adhesion of the sporidial beak or germ-tube to the leaf surface through the action of its mucilaginous investment. A very careful study of the cuticle at the point of entry revealed no swelling or alteration in its staining properties, and there was no evidence of any chemical action on it.

Even in hollyhock leaves, in which there are stomata on the upper surface, the author confirmed Eriksson's observation that the sporidia of *Puccinia malvacearum* infect by direct penetration of the cuticle.

TRUE (R. H.). **The significance of calcium for higher green plants.**—*Science*, N. S., lv, pp. 1-6, 1922.

After a brief review of the literature of the subject, the results of work carried out by the author and his collaborators are discussed.

When seedlings were grown in solutions of Ca and Mg salts there was a well-defined equilibrium concentration below which the roots were not able to absorb, and ions leached out from the roots to the medium. Above this minimal point absorption took place in greater or less measure. At no concentration tried (up to 900×10^{-6} gm. norm. per litre) was there any evidence of injury from Ca, but in the stronger solutions Mg caused characteristic injury and death.

The presence of Ca ions also permitted the absorption of other nutrient ions that, offered in unmixed solutions, would be unabsorbable, and enabled the plant to retain ions that in their absence it would be unable to retain. In other words, the Ca ions may be said to make the others physiologically available to the plant. Thus when the soil solution is deficient in Ca ions, other nutrient ions present are largely out of reach, and such a solution may even leach mobilized nutrients from seedlings.

The rôle of Ca in the cell-wall is then discussed. The calcium pectate of the middle lamella has been previously shown to be a stiff colloid formed when pectic acid meets Ca ions. According to various authors, this acid results from the action of the enzyme pectase on the mother substance pectin.

There appears to be considerable freedom in the shifting of cell-wall materials into and out of the pectic acid condition, and (when Ca ions are present) the consequent appearance of calcium pectate layers. These shifts appear to be due to self-regulated chemical responses to stimuli, the internal causes being perhaps due in the first instance to external conditions. From the work of Sampson (*Bot. Gaz.*, lxvi, pp. 32-52, 1918) it would appear that the abscission phenomena in injured *Coleus* plants are due to a change of cellulose

into pectic acid, induced by irritation stimuli, and the pectic acid, being greatly in excess of the Ca ions, creates a thin, mechanically weak, colloidal medium. In proportion as the pectic acid exceeds the Ca, the latter is diluted and removed from its original seat. The conversion of cellulose into pectose is stated to be a usual feature of ageing cell-walls, and the shift from pectose to pectic acid follows easily. The changes in firmness of fruits and vegetables resulting from the action of parasitic or saprophytic fungi seem to be due to the removal of Ca by acids formed directly or indirectly by the fungi, so that the firm pectate layers become pectic acid or something closely akin; since the latter lacks mechanical strength, softening of the tissues follows.

Both K and Mg can replace Ca in forming pectate walls. The K pectate is readily soluble in water, and its presence causes a great increase in the permeability of the cells, so that organic substances will leach out from the roots into the solution; and, in the opposite direction, copper sulphate, for example, will be taken up rapidly into all the tissues of the root. Mg pectate is less permeable than K pectate, but more permeable than Ca pectate. Fatal action to roots in Mg solutions does not develop until all the Ca of the middle lamella has been replaced by Mg. It is suggested that Mg ions can then penetrate the deeper structures of the cell. No kation has been found which can replace Ca in the middle lamella without injury to the plant.

Cell-walls and protoplasm are in close relationship. For instance, a dozen or more layers of cells surrounding the embryo of wheat are, during germination, absorbed, and finally the innermost walls of the ovary are cemented to the outer integument. The protoplasm seems to extrude substances through the cell-wall to form this cementing substance. These substances are perhaps Ca ions and pectose.

A certain quantity of Ca ions must be in the medium in order that plants may grow normally. Other ions required by the plant are unabsorbable in the absence of Ca ions. Thus some light is thrown on the practical problem of the value of lime in soils, and these observations on cell physiology suggest one way, perhaps of many, in which higher green plants find calcium necessary.

JOHNSON (J.). **The relation of air temperature to certain plant diseases.**—*Phytopath.*, xi, 11, pp. 447–458, 2 figs., 3 pl., 1921.

The author gives a general review of his experiments at the Wisconsin Agricultural Experiment Station in examining the part played by atmospheric conditions in the occurrence and severity of plant diseases. For this purpose, chambers in which the temperature and humidity of the air were controlled, the construction of which is fully described and illustrated, were used.

Temperatures as low as 12° or 15° C. could be maintained only during the winter months, when the greenhouse temperature was kept at or below 22° C. The humidity in the chambers was controlled within a normal variation not exceeding two or three per cent. Provision was made for the regular renewal of the air, and the evaporating power of the air was measured in each chamber. On the whole, the methods adopted proved satisfactory, their few

defects not being sufficient to influence the final results of the experiments. In the present paper some temperature relations of mosaic and wild fire of tobacco and late blight of potato are considered.

Two methods were used in investigating the influence of temperature on tobacco mosaic. In the first case the plants were inoculated and left in the chambers for a fortnight, when they were placed on a greenhouse bench at a temperature varying from 18° to 24° C. The second method consisted in placing already diseased plants in the chambers and there observing the course of the disease. The incubation period was longer in full winter than in February and March, presumably owing to the slower rate of growth of the host plant. Air temperature has a marked effect on the incubation period, the optimum for the activity of the virus being between 28° and 30° C., and the maximum nearly 36° C. The absolute minimum is perhaps undeterminable as the development of the symptoms is slowed down by reduced growth of the host plant, and symptoms are probably not produced at all unless there is some growth of the host, which does not occur at low temperatures. When severely affected plants are placed at a temperature of 36° to 37° for about a fortnight, the newly developing leaves are free from mosaic, while the older ones regain a more or less normal appearance. This is probably due to the arrest of the detrimental action on chlorophyll production, but the reappearance of the symptoms when the plants are subjected to a lower temperature shows that the virus is still present. The optimum temperature for enzymic activity usually lies between 37° and 40° C., and in this respect the results are considered to furnish further evidence against the enzymic theory of mosaic diseases.

The effect of soil temperature on tobacco mosaic appears to be largely a matter of growth response in the host, air temperature being of much greater significance; thus a soil temperature unfavourable for host development will increase the incubation period, even when an air temperature favourable for the host and virus is maintained.

Tobacco plants inoculated with the 'wild fire' organism, *Bacterium tabacum* Wolf and Foster, were placed in the chambers simultaneously with the mosaic disease series, infection being produced through needle-pricks from a suspension of the organism in water. Conclusive evidence was obtained that the progress of wild fire under the conditions of humidity maintained is very vigorous in wounded leaves at a temperature as high as 34° C., the optimum being between about 27° and 32°, and the maximum apparently just beyond 37° C. Infection can occur and progress at a relatively low temperature, the minimum being below 15°. The maximum temperature for the growth of *Bact. tabacum* in culture is apparently close to 35° C., the optimum temperature probably ranging from 25° to 30°. The wild fire organism thus is capable of attacking the tobacco leaf at a temperature at which it does not seem able to grow in culture.

In experiments on the late blight of potato (*Phytophthora infestans*) the plants were usually inoculated and left outside the chambers until signs of infection occurred, when they were placed

inside at different temperatures. The progress of the disease was shown to be insignificant below 25° C. as compared with that at higher temperatures. The optimum appears to be between 25° and 32° and the maximum above 36°. The most important fact demonstrated was that *Phytophthora* is a fairly vigorous parasite at temperatures as high as 32° to 35° C. The action of the fungus on the host corresponds closely with its growth in culture in the same temperature chambers, though, as in the case of *Bact. tabacum*, the fungus seems to be relatively more vigorous on the host than in culture. Growth was appreciable on potato agar at 35–36° C. Hence it is concluded that the progress of late blight of potato is favoured by relatively warm humid weather, though it is known that original infection by zoospores is promoted by low temperatures. Late blight should, therefore, be most severe when these low and high temperatures succeed each other at the proper interval of time.

TRÖNDLE (A.). **Über den Einfluss von Verwundungen auf die Permeabilität nebst ergänzenden Beobachtungen über die Wirkung des Sauerstoffentzuges.** [Notes on the influence of wounding on permeability, with complementary observations on the effects produced by deprivation of oxygen.]—*Beihefte Bot. Centralbl.*, xxxviii, Ab. 2, 3, pp. 353–388, 1921.

The writer's experiments were carried out on young roots and leaves of *Lupinus albus*, *Vicia faba*, *Allium cepa*, and *Pisum sativum*, principally the first two, and while agreeing in the main with the outcome of previous work, the results obtained extend our knowledge respecting the influence of traumatic action on the biological processes of plants. It has been demonstrated that not only may an injury bring about an important reduction in the permeability of the cells, but that this reduction can, under certain conditions, extend to the complete inhibition of the absorption of salts. The reaction is discernible after a very short interval, probably less than ten minutes, and the area affected and also the vigour of the reaction depend on the strength of the stimulus and the distance of the cells from the wound. The radial distance through which the action was perceptible in these experiments was up to 1·5 cm. or more. There is a distinct connexion between the length of time during which the stimulus acts and the vigour of the response of the reaction. Thus, up to a certain optimum time of action the reaction increases, but beyond this point, as the irritability is dulled, the reaction gradually diminishes again until a normal condition is once more reached. It was found in needle-prick injuries that the reaction was distinct after ten minutes, reached its maximum in thirty minutes, and a continuation of the stimulus after this time was followed by a gradual diminution of the response until after about two hours normal conditions were restored. In regard to the influence of distance from the wound, it was found that there was complete inhibition of the absorption of salts in the immediate vicinity of the wound, gradually shading off to normality as the distance increased.

The strength of the stimulus depends to a great extent on the nature of the injury. Thus the complete separation of portions of

tissue brought about by incisions influences the largest area, decapitation of the root comes next, then needle-pricks in large numbers, while the weakest response was obtained by the application of two needle-pricks.

The effect of the wound stimulus in reducing the permeability can be balanced by placing the injured roots in hypertonic solutions; the absorption of salts then depends on the strength of the concentrations. The loss of permeability is therefore not due to the production of a condition of rigidity in the protoplasm. A reduction in permeability also occurs through immersion of the roots in pure hydrogen. This action is believed to be due to the effect of a lack of oxygen on the living protoplasm.

The significance of the wound reaction here described in conserving the cell substances through the closing of the cells to their passage outward is referred to.

YOUNG (H. C.) & BENNETT (C. W.). **Studies in parasitism. I. Toxic substances produced by fungi.**—*22nd Report Michigan Acad. Science*, 1920, pp. 205–208, 1921.

It was reported by Coons and Goss (*Report Michigan Board of Agric.*, 1917) that the filtrate from cultures of *Fusarium oxysporum* was as effective as the fungus itself in causing wilting of potato plants.

The authors have confirmed this in experiments with a virulent strain of *F. oxysporum* grown on Richards's solution having a PH value of 5. The effect of the filtrate on freshly cut stems of potato, tomato, and celery was determined at periodical intervals. It was found that the growth of the fungus at first increased the acidity of the solution until a PH value of 3·8 was reached, but the acidity then progressively decreased until at the end of forty days the solution was distinctly alkaline (PH 7·4). The filtrate caused wilting in all three plants tested, the period required to induce wilting becoming shorter (from forty-eight to eight hours) as the culture grew older and the solution less acid, in the case of the potato, while with the other two plants the time required first decreased, then increased, and finally decreased again. The wilting was evidently not due to the formation of acids, but to some substance of an alkaline nature or which was formed when the solution became alkaline. The time required to cause wilting rapidly decreased after the PH of the filtrate was higher than that of the cell sap (4·8 to 5·8 in potato and tomato). But wilting was not hastened by altering the reaction of uninoculated Richards's solution, the period of wilting remaining constant (forty-eight hours) when cut potato stems were placed in a check solution at all values from PH 3·8 to 7·4.

Further research showed that autoclaving for fifteen minutes or boiling for thirty minutes did not alter materially the wilting period of the filtrate, nor was it affected by filtering through Berkefeld filters or diatomaceous earth. A test for alkaloids gave a positive reaction, but when the ether soluble alkaloids were separated and brought to the same concentration as the original filtrate, the wilting period was greatly increased. The alcoholic precipitate of the filtrate, with reaction and concentration brought to that of the

original filtrate, was effective in causing wilting of potato stems. The active factor may be an alkaloid, toxin, or enzyme, but can scarcely be an organic acid.

GRAM (E.). **Ti Aars Sprøjtningsforsøg.** [Ten years' spraying experiments.]—Reprinted from *Jydsk Landbrug*, xxvi, 7 pp., 1921.

This gives a summary of the results of over 800 experiments in spraying of potatoes against blight (*Phytophthora*), conducted in various parts of Denmark from 1911–20. The average increase in yield due to spraying is estimated at 12 to 14 per cent. for the whole period. In years in which there was no disease the spraying increased the gross weight of the crop by two per cent. It should therefore be carried out every year. The experiments show that, generally speaking, the increase of dry substance is proportionately higher than that of the gross weight. Thus, estimating that spraying increases the gross weight from 100 to 110, the tubers from sprayed plants will also contain one-half to one per cent. more dry substance than an equal weight of tubers from unsprayed plants. This rule applies especially to the variety Richter's Imperator.

The best time for digging sprayed potatoes appears to be during the first few days of October. Thus in 1919 sprayed potatoes dug on 2nd October gave a yield of 21 per cent. more than unsprayed. Even as early as 18th September there was an increase of 13 per cent. over those not sprayed. Long delay is apt to lead to a slight diminution in the yield, especially of unsprayed potatoes.

Practically all the experiments point to the advisability of spraying twice rather than once a year, the increase in the yield being 15 to 18 per cent. and 10 per cent. respectively. In cases where only one spraying is practicable, all preparations should be made by the middle of July, and the treatment applied on the first day the disease is observed. The best results are likely to be obtained by the use of 2 per cent. Bordeaux mixture twice a year. Excellent results have also followed the use of 1 or 2 per cent. Burgundy mixture.

KÖCK (G.). **Die Schwarzbeinigkeit der Kartoffeln, ihre Ursache, wirtschaftliche Bedeutung und Bekämpfung.** [Blackleg of Potato, its causes, economic importance, and control.]—Reprinted from *Oesterr. Zeitschr. für Kartoffelbau*, i, 9, 3 pp., 1921.

In 1921 blackleg of potato (*Bacillus phytophthorus* Appel) was more severe in Austria than ever previously recorded. The author gives a short popular description of the disease and emphasizes the necessity of controlling it by the careful selection of seed-tubers. No seed should be taken from diseased plants, and if a field is badly infested it should not be sown with potatoes for a period of three to four years. The present system of certifying seed potatoes followed in Austria is the same as in Germany, up to ten per cent. of blackleg plants being allowed, but the author thinks that the

experience of the last year indicates the necessity for more stringent regulations, as in America, where only 2 per cent. is allowed.

KÖCK (G.). **Einiges über Kartoffelkonservierungsmittel.** [Remarks on preparations for the preservation of Potatoes.]—Reprinted from *Oesterr. Zeitschr. für Kartoffelbau*, i, 10, 4 pp., 1922.

Of late years heavy losses have been sustained in potatoes stored for the winter in pits and cellars, from various types of rot (*Phytophthora*, *Fusarium*, bacterial rot) in Austria. Attempts at preventing or reducing this damage, especially the spread of infection from diseased to sound tubers after storage, by dusting the potatoes with sulphur, gave negative results. Various proprietary preparations for the same purpose have been introduced in Germany and Austria, three of which, Megasan K, Beka-Erdäpfelschutz, and Uspulun-Colus, have been officially tested in carefully controlled experiments. The results were unsatisfactory and their use in practice is not advised. The only measures that can be recommended at present are to remove carefully all diseased potatoes before storing; care should also be taken to store the potatoes in as dry a condition as possible in dry pits or cellars, well protected against frost and as well ventilated as possible, while in the case of store cellars the walls should be freshly whitewashed before use, and the tubers should be examined once or twice during the winter in order to pick out all rotted ones.

JANCHEN (E). **Die Dürrfleckenkrankheit der Kartoffeln.** [Early blight of Potatoes.]—Reprinted from *Oesterr. Zeitschr. für Kartoffelbau*, i, 6, 3 pp., 1921.

The author gives a popular account of early blight of potatoes caused by *Alternaria solani* (E. and M.) Jones and Grout, for which are given as synonyms *Macrosporium solani* Ell. et Mart. and *Sporidesmium solani varians* Vanha. The disease is stated to occur in Austria, Hungary, and Czecho-Slovakia, and has been at times confused with *Phytophthora* blight. Like the latter, it is said to attack tomatoes also. The thin-leaved early varieties of potatoes are said to be more susceptible than the thick-leaved late ones. In severe attacks the yield may be seriously reduced.

Successful control can be secured with copper fungicides such as Bordeaux mixture or Bosna paste. The first application should be made as soon as the spots appear and should be followed by one or two more at intervals of two to three weeks. The removal and burning of diseased parts at the end of the season and rotation are other useful measures.

MURPHY (P. A.). **Investigation of Potato diseases.**—*Canada Dept. Agr. Exp. Farms Bull.* 44, 2nd ser., pp. 1–86, 35 figs., 1921.

Investigations of late blight, blackleg, leaf roll, mosaic, and curly dwarf and related diseases in Canada are reported.

Late blight (*Phytophthora infestans*) is very serious in eastern Canada. During the five years 1915 to 1919 an average of 21·3 per cent. of the crop from unsprayed plants developed rot during storage. An average of 130·5 bushels per acre yearly increase in

yield of marketable potatoes was obtained from spraying with Bordeaux. A minimum of four thorough sprayings at about two week intervals, beginning about the first of August, is recommended for Prince Edward Island. The cost per application per acre is figured at $0·70 to 1·65 according to the type of sprayer and amount of material used. Home-made Bordeaux mixture was found to give better results than Burgundy mixture or commercial preparations. Lime sulphur was worse than useless on potatoes. It was found to be better to spray before rather than after a rain, provided the spray had had a chance to dry. The rot of tubers may be caused by *Phytophthora* alone, but frequently bacteria or *Fusaria* gain entrance to tubers primarily injured by the *Phytophthora*. It is concluded that late blight is the preponderating cause of tuber rot in the Maritime Provinces. A report of studies on the factors which influence rot infection is made, and indicates that the surface soil contaminated with shed conidia is a more serious source of infection at harvest-time than partly blighted foliage, and is also more serious than subterranean infection by conidia washed down into the soil during the growing period. Experiments clearly showed that rot is considerably reduced by removing the foliage two weeks or more before digging the tubers so as to allow enough time for the shed conidia to be killed; nine days was not enough to render the soil free from infection. Imperfect spraying, especially when stopped too soon, may result in more rot in the tubers than no spraying, because it may keep the foliage green and in an infective condition until harvest-time. Other practical suggestions for preventing rot are given.

Blackleg (*Bacillus atrosepticus*) is sometimes severe in eastern Canada, particularly under damp and cool conditions. The disease was not found to spread in the field, nor to attack a plant unless the sett was already infected. The tuber rot was not found to spread in storage under the conditions observed. Tests of treating setts and uncut tubers with solutions of corrosive sublimate and formaldehyde showed that some injury follows the treatment of setts. The temperature during June seems to be the critical factor in determining the amount of blackleg that will develop.

Leaf roll is discussed at length and is reported to be rare in the Maritime Provinces, but common in Ontario and Manitoba. The 'primary stage' of leaf roll, as described by Dutch workers, is rare or absent in Canada. The disease reduces the yield greatly, but was not found to become more severe in successive years, nor were any plants observed to recover from it; tubers from diseased plants always carry the infection to the new plant. The locality in Canada in which uniform trial lots of healthy and leaf roll potatoes were grown was found to influence the yield, the best yields from leaf roll (and also from mosaic) seed being obtained from regions with the highest average temperatures. Infection was found, as has been previously recorded, to spread from diseased to healthy plants in the field. The disease was not induced by merely exposing the plants to unfavourable environmental conditions. Different tubers from the same plants were planted in Bermuda, Prince Edward Island, and Ottawa, and gave practically identical plants, healthy or leaf roll, in the three places. Infection of neighbouring plants was

found to take place more rapidly in Bermuda than in Prince Edward Island. In tests throughout Canada it was found that infection to neighbouring rows developed most extensively at Ottawa, where it crossed five rows. At Thunder Bay, on the other hand, no spread was noted. Leaf roll is considered to spread through the soil in Canada, perhaps through the agency of some soil-inhabiting animal. The soil was not found to remain infected. The questions of varietal susceptibility and general control are discussed; the Green Mountain group is stated to be but little affected; clean seed, selection, and the use of seed plots are recommended.

Mosaic is prevalent in most of the Maritime Provinces, Quebec, and Ontario, especially on Green Mountain, Bliss Triumph, and some other varieties. It is reported occasionally not to develop on plants grown from the tubers of diseased plants. It was found to be more infectious than leaf roll, but no evidence was obtained that it becomes progressively worse in succeeding years. As in leaf roll, the locality has a marked influence on the severity of the disease, both diseases being affected in the same way. In western Canada the symptoms may be suppressed. Early planted potatoes developing under cooler conditions may show worse mosaic symptoms than potatoes planted later. Mosaic may spread considerable distances, probably by insect carriers. Spread to adjacent plants occurred at Thunder Bay, where there was no spread with leaf roll.

Curly dwarf is considered to be rare or absent in Canada.

Crinkle is described as a disease probably distinct from mosaic and leaf roll, in which the plants are bushy, dwarfed, somewhat paler than healthy plants, and the leaves are puckered and curved downward. Instead of distinct spotting, diffused, slightly yellowish areas occur over the foliage. As death approaches this colour is heightened, and accompanied by rusty brown spots. The foliage is brittle and easily injured. Affected plants were not found to recover. Crinkle is considered to be responsible for a serious 'degeneration' of potatoes at Ottawa, probably having been brought in from Europe. It is believed to be identical with the form of curly dwarf described by Quanjer in Holland as 'Welfingziekte', but to be distinct from ordinary European curly dwarf. Mosaic does not develop into crinkle at Charlottetown (Prince Edward Island), nor were plants affected with crinkle found to develop mosaic symptoms in that locality. Both diseases may be present in the same plant.

Leaf drop is differentiated as a disease in which the leaves drop, from the lower upwards. The plants are upright in habit and the leaves may be puckered or normal. Eventually the plant stands as a bare stalk with a cluster of yellow leaves at the top. A slight browning of the vascular area of the tubers was found, and bacteria were isolated but did not prove pathogenic. The disease may, however, be similar to Appel's 'bacterial ring-disease'. Leaf drop is transmitted by the tubers, and some of the observations indicate that both it and crinkle are infectious diseases capable of being transmitted from one plant to another in the field. It is second to crinkle as a cause of deterioration of potatoes (Green Mountain and Irish Cobbler) near Ottawa, and also occurred at Charlottetown, where it was first noticed in 1913 on imported potatoes.

Streak, as described by Orton, was found, and proved to be infectious by introducing diseased tissue into a healthy petiole, but no causal organism was isolated. It is considered that tubers from diseased plants may give rise to extremely dwarfed plants the following year. Spread by insects is suspected.

The author considers that the term 'curly dwarf', as commonly used, refers to a complex of diseases, the real relationships of which are not yet determined, and suggests that the name should be restricted to the type described and figured by Appel.

MURPHY (P. A.). **The sources of infection of Potato tubers with the blight fungus, Phytophthora infestans.**—*Sci. Proc. Royal Dublin Soc.*, xvi (N. S.), 29, pp. 353–368, 1921.

Phytophthora tuber rot may be more abundant following a less severe attack of the foliage blight, occurring late in the season, than when it follows a severe outbreak which runs a rapid course. Increased tuber infection may occur if the plants are sprayed early in the season but the later spraying is omitted. Any circumstance which preserves the foliage until late in the season but then allows it to become partially blighted increases the amount of disease in the tubers. Under such circumstances the tuber rot develops most seriously some time after digging the potatoes. The bulk of potatoes which develop the blight in storage contract infection when the tubers are being dug, and the amount of blight thus developed is, generally speaking, in relation to the amount of blight on the above-ground parts at and previous to the time of digging. This infection comes about either from contact of the tubers with partially blighted foliage, or from contact of the tubers with soil contaminated by spores shed fairly recently from the leaves. Such contaminated soil remains capable of inducing blight in freshly dug tubers which are brought in contact with it over a period of at least ten days, and probably longer. Evidence was obtained that the blight does not spread from tuber to tuber even in moist pits to any considerable extent, if at all. The field and experimental data were obtained in eastern Canada [see last abstract] and in Ireland.

MURPHY (P. A.). **The bionomics of the conidia of Phytophthora infestans (Mont.) de Bary.**—*Sci. Proc. Royal Dublin Soc.*, xvi (N. S.), 34, pp. 442–466, 1922.

The experiments here described prove that conidia of *Phytophthora infestans* (Mont.) de Bary, kept in soil out of doors during a period of dry weather, may remain viable and capable of infecting potato tubers for a period of at least three or four weeks. The spores were found to retain their vitality longer in loam than in a quick-drying medium like silver sand in tests carried out in Petri dishes in the laboratory, the soil being uniformly slightly moist at the beginning of the experiment. In the same kind of soil (loam) kept indoors in pots, they survived for twenty-six days when the soil was waterlogged and forty days when it was nearly dry or moderately moist. Contaminated dry soil kept in plugged tubes in a saturated atmosphere at 20° C. infected tubers in some cases as freely after forty-four days as when fresh. This was the longest survival obtained.

It is noted that conidia placed in soil remain without producing any apparent mycelium. They are able to survive temperatures up to 30° C., providing sufficient moisture is present, for twenty-six days, but a lack of moisture and high temperature is a fatal combination. It was found impossible to keep ungerminated conidia in an infective condition in air saturated with water-vapour for more than nine days. Large quantities of water, passed slowly through initially contaminated surface soil, failed to destroy the latter's power of infecting tubers after more than four and a half days, and at any time during this period the soil itself was more infective than the water which had passed through 10 cm. of it.

Germination proceeds actively at temperatures of 10 to 15° C., when, as a rule, zoospores result, germ-tubes being produced in small numbers; exceptionally, the majority form germ-tubes, this being apparently due to some condition of the conidia themselves. Nutrient solutions do not seem to favour germination by tube, but they tend to impede perfect zoospore formation, which on the other hand is stimulated by abundance of oxygen and by the absence of competing organisms, such as bacteria, protozoa, and *Penicillium*. Germination by a germ-tube is the regular method at 22°–23° C., but far fewer spores germinate than at the lower temperatures; it is also the usual method in old conidia. Germination which has been delayed through lack of oxygen or by contamination with the organisms mentioned, or by thick seeding of conidia, or by ringing cover-glasses with paraffin, may subsequently be induced by the addition of fresh water, and is then usually by germ-tubes.

By reducing the supply of oxygen to a point which just permits germination, or by gradually cutting it off altogether after germination has occurred, the so-called secondary conidia are produced. As they are usually formed under water, the term 'hydro-conidia' is suggested. They have a characteristic appearance, with a prominent papilla and a yellowish oil drop. Not only are they formed on the germ-tubes of conidia after limited growth, but smaller though otherwise similar ones are borne by germ-tubes from zoospores. They are materially more resistant to unfavourable conditions in water than are the ordinary conidia. They germinate usually by germ-tubes (of which there may be several arising from any part of the spore), which may again bear a tertiary conidium, and the process may be repeated at least once more; under favourable conditions, however, zoospores may be produced. The germination of secondary conidia has been observed twenty-four days after the original conidia were placed in water, and the germ-tubes from these were still living after ten days more.

The germination of the zoospores is favoured by an abundant supply of oxygen. Their germ-tubes can live for at least a week in water, and when secondary conidia are formed it is probable that this period can be prolonged.

It is believed that the conditions of the soil atmosphere, particularly its fluctuations in oxygen content, are such as would account for the prolonged vitality of the fungus in the soil by means of the processes here described. This is in sharp contrast to the limit of existence of fresh ungerminated conidia in competition with other organisms in water, which is about five to seven days. Hence,

unlike most fungi, the endurance of *Phytophthora infestans* increases after germination of its spores: at any rate, under conditions that are commonly met with in nature.

LÖHNIS (MARIA P.). **Onderzoek over Phytophthora infestans (Mont.) de Bary op de Aardappelplant.** [Observations on *Phytophthora infestans* (Mont.) de Bary on the Potato plant.] —[Thesis submitted to the Rijks University of Utrecht.] H. Veenman, Wageningen [Holland], 96 pp., 6 pl., 1922. [English summary.]

Phytophthora infestans, *P. nicotianae*, and *P. erythroseptica* grew abundantly on white bean agar with as much as 40 per cent. of saccharose, and some growth was made even with a saccharose concentration of 60 per cent. Sporangia were produced in concentrations up to 25 per cent. of saccharose. Immature oogonia and oospores of *P. infestans* were found twice in cultures on raw potatoes, and also on Quaker oat agar. Zoospores were formed in a minimum time of thirty minutes in water at 8 to 18° C. The spores lost their power of germination after one hour's exposure to the air in a room.

The mycelium of *P. infestans* in potato tissue can be stained differentially by a solution of Sudan III in alcohol-glycerine. The mycelium may grow intercellularly by replacing the middle lamella, or intracellularly. No mycelium was found in cork cells or vascular bundles. In infected tubers the eyes are usually surrounded by a small area of healthy tissue, or are dried up, but once or twice the mycelium was found to grow out of a very young bud in a raw potato culture. In potato leaves the blackening of host cells keeps pace with the progress of the mycelium, but in tubers the discoloration produced occurs after the mycelium has penetrated some distance. The browning of the tissue in tubers is considered to be a host reaction rather than a toxic effect. The author never found the mycelium of the fungus growing from a diseased tuber into a sprout, and blight developed no earlier on plants from infected tubers than on plants from healthy tubers in several experiments; the author concludes that the 'appearance of late blight appears to be possible in the absence of infected seed tubers, and while infection from neighbouring fields is impossible. The infection of the sprout from the diseased seed tuber is not the normal way of propagation from season to season.' No evidence was obtained that *Phytophthora* spores were introduced into fields on the surface of the tubers planted.

In five instances a diseased tuber was found in the soil before *Phytophthora* appeared on the leaves, and in two of these instances subsequent leaf infection did not occur. This is considered to 'point to another way of existence of *Phytophthora* than in the potato plant'. Whether this is in the soil or not has not been determined. While it is probable that the stage of development of the host-plant has some influence on the moment of outbreak of the disease, it is not considered to have any effect on susceptibility to contamination from neighbouring infected plants. Under laboratory conditions young sprouts can be readily infected.

The evidence obtained indicated that infection of tubers in the

field probably occurs normally through slight wounds in the potato skin, and not through the eyes, lenticels, or unbroken epidermis.

Experiments were made to determine whether *P. infestans* might spread from tuber to tuber in the soil by way of the stolons, but the results indicate that this method of spread probably does not occur. Healthy tubers with wounds may be infected by contact with diseased tubers during digging or in storage. The length of time during which infection can occur after a wound has been made in a tuber varies with the stage of ripeness in the tuber. In young tubers in July no infection was obtained by inoculation after three days from the time the wound was made; in winter, infection was still possible twenty-six days after wounding. Wound-cork does not appear to be the only factor, however, that protects against infection.

The mechanism of resistance of tubers to infection was studied. No differences between resistant and susceptible varieties as to rate of growth of the fungus in the parenchyma, thickness of skin, or rate of wound-cork formation was found. The variety 'Bravo', which produces tubers resistant to the disease, differed from other varieties tested in that there was a tissue of highly resistant quality in the boundary layer between cork and parenchyma. The reason for resistance of leaves of certain varieties to infection is uncertain; osmotic pressure relations can hardly determine the degree of resistance, since, as noted above, the fungus grows normally in cultures in agar with sugar at a higher osmotic pressure than is ever found in the leaves.

MARRE (E.). **La sélection des Pommes de terre en Hollande.** [The selection of Potatoes in Holland.]—*Rev. de Bot. appliquée*, ii, 8, pp. 129–132, 1922.

The writer gives an account of the methods employed in Holland to preserve healthy potatoes from degeneration. The first step consists in harvesting the tubers from a field of healthy plants, rejecting any plants which show the slightest trace of disease or a poor yield. The following January or February another inspection of the seed-tubers is made, those finally selected being planted in an isolated field which has not been used for potatoes for three or four years at least. The tubers of each plant are kept separate and are planted in order of size in rows at a distance of at least four metres apart, the intervening spaces being occupied by beetroots, beans, or other crops not belonging to the Solanaceae. As early as possible any plant showing signs of disease is eliminated, so that the harvest consists of the tubers of healthy plants only. The same process is repeated in the third and fourth years, only those strains being propagated which have throughout remained healthy.

This method of individual selection is undoubtedly superior to any other, but on account of the time and care which it exacts the method of mass selection may be substituted. The latter consists in eliminating from the field any diseased plants or healthy plants immediately surrounded by diseased ones, and mixing the yield from the remainder.

Quanjer has shown that degeneration is a result of infection, which acts more rapidly on certain soils, especially turf. An

experiment with various kinds of soil showed that potatoes planted in clay retained their health better than those grown in sand, turf, or reclaimed meadow-land. Quanjer attributes this decline of potatoes on turfy soil to the greater prevalence of aphids in such localities.

QUANJER (H. M.). **New work on leaf curl and allied diseases in Holland.**—*Royal Hort. Soc., London, Rep. Internat. Potato Conference of 1921*, pp. 127–145, 20 figs. [Received March, 1922.]

The following diseases of the potato are described and illustrated:

Leaf roll does not become manifest in newly infected plants until the middle of summer, and sometimes the foliage symptoms may not appear until the following season. The first symptoms (primary leaf roll) are a rolling and upward position of the upper leaves, the upward bending of the stalks of leaves and leaflets being typical. Sometimes a reddish colour is prominent on these upper leaves. The progeny of primarily diseased plants produces secondary leaf roll, in which the lower leaves show the symptoms at the beginning of summer. The rolled leaflets stand upright and are funnel-shaped, rigid, and brittle; a yellowish discoloration proceeds from the tips and the margins, followed in certain varieties by a reddish or violet tinge. Phloem-necrosis always occurs in the stalks and veins of leaf roll plants, and the transport of starch from the leaves is inhibited. This is the only one of the diseases in which pathological changes in the phloem have been found. Secondary leaf roll plants remain small and produce only a few small tubers. Net necrosis and spindling sprout have not been observed as regular symptoms of the disease. As shown by Oortwyn Botjes in 1920 and Schultz and Folsom in 1921, aphids transmit the disease. In the field, the more the climate favours the development of aphids, the farther the infection goes. Tomatoes and other Solanaceous plants infected by grafting with tops of affected potatoes, may carry leaf roll without showing the symptoms as clearly as potatoes show them, and can afterwards infect healthy potatoes by grafting. No other insect was found so well adapted to transmit leaf roll as aphids are.

Marginal leaf roll is rarer, the rolling is restricted to the borders of the leaflets, and phloem-necrosis does not occur. Its infectiousness is not yet determined.

Mosaic is characterized by pale patches on the leaflet, which differ but little in shade from the darker portions; the mottling is quite indistinguishable in hot, dry summers, and faintly diseased plants show then only a somewhat crinkled and glistening appearance. The progeny of infected plants develops a crinkled or curled appearance, which takes the form of curly dwarf in certain varieties. It is known that aphids carry the disease, and it can be transferred by grafting to tomato and tobacco, but not by rubbing healthy plants with diseased.

Aucuba-mosaic (so called on account of its resemblance to the variegation of *Aucuba japonica*) is characterized by prominent localized yellow patches. It is not serious. The leaves do not curl.

It can be transmitted by grafting to other potato or tomato plants, but on the latter it is distinct from the common tomato mosaic. When Aucuba-mosaic potatoes are grafted on *Datura stramonium*, *Solanum dulcamara*, *Nicotiana tabacum*, *Atropa belladonna*, and *Hyoscyamus niger* these plants do not show symptoms, but will transmit the disease back to potato.

Duke of York mosaic is named from the variety of potato on which it was first found. Pale patches occur between the veins of the leaflets, and the margins of the leaflets curl upwards slightly.

Crinkle is a disease described first by Murphy in Canada [see above, p. 250] and present in England, Scotland, and Holland. The symptoms resemble those of mosaic, but there are marked corrugations, and the margin and tips of the leaflets curl downwards. The leaflets are brittle, turn yellow prematurely, and the lower leaves may drop off. Necrotic areas are often found in the parenchyma, near the conducting tissues of the phloem. It can be transmitted by grafting to potato, tomato, *Hyoscyamus niger*, *Datura stramonium*, and *Atropa belladonna*, and field observations indicate that it is probably also carried by aphids like leaf roll and mosaic.

The author traces briefly his work on these diseases in Holland, and gives observations made during his travels in other countries. He has isolated the diseases mentioned above in pure form, and finds it a useful practice to transmit questionable cases of disease to a variety in which the reaction to the various diseases is known.

These several diseases are not considered to winter over in the soil. The possible nature of the causative agents is discussed briefly, the author declaring in favour of ultra-microscopic organisms, of which there must exist a whole world. Leaf roll, mosaic, and crinkle were found in wild South American species and varieties of potato.

Control measures are discussed, and it is considered that the losses caused by these diseases may be reduced by a proper system of seed selection.

PERRET (C.). **Sur les maladies des Pommes de terre.** [Report on Potato diseases.]—*Ann. des Épiphyties*, vii, pp. 304–314, 1921.

As a result of experiments and observations made in 1920 at the Experiment Station of Merle (France), the author states that three types of potato degeneration are prevalent in the basin of the Loire, namely: (1) Leaf roll type (Quanjer's phloem-necrosis) characterized by a peculiar deformation of the foliage, the production of the tubers in close proximity to the base of the stem, and lesions in the sieve-tube tissues of the stalk. This type of degeneration seems to be but little influenced, if at all, by the mode of storage of the seed-tubers and is not to be detected by germination tests. (2) Type producing dwarfed plants or sterile tubers (probably 'filosis'). Cases of mosaic seem to be associated with this type, but the author is not yet in a position to establish a definite correlation between mosaic and filosis. The development of this form of degeneration is delayed by storing the seed tubers in cold and aerated rooms and by exposing them to light before sowing. (3) Mixed type, with characters of both the preceding. In all three types a considerable proportion

of the seed tubers remain undecayed during the growing season. While both phloem-necrosis and mosaic diminish considerably the yield of the crop, they do not seem to have any appreciable influence on the chemical composition of the tubers. In plots planted for three successive years with three varieties introduced in 1918 the percentage of leaf roll in each succeeding year was 0, 50, 100; 0, 30, 50; and 20, 90, 100 respectively, showing the progressive increase of the disease year by year. No *Phytophthora* attacks have been noticed at Merle during the last three years, and this fungus does not seem to play any part in the degeneration of the leaf roll type. Manuring experiments showed that nitrogenous manures in high doses help in reducing the gravity of phloem-necrosis and mosaic symptoms, but not in eliminating these diseases; they have no restrictive action either on blackleg or *Rhizoctonia*, and do not help in reducing the number of tubers attacked by the common scab. Two of the varieties studied were characterized by great resistance to leaf roll, with susceptibility to mosaic and *Phytophthora*. The experiments showed that all seed tubers from a plant suffering from phloem-necrosis give rise to plants with symptoms of leaf roll, while a seemingly healthy plant, growing among diseased ones, may produce either healthy or diseased progeny. The author concurs in Quanjer's view that there are no immune plants, some plants remaining accidentally free from disease. He is also inclined to agree with Quanjer as to the contagious nature of phloem-necrosis, although some observations would seem to contradict this theory. The control measures recommended are a careful and systematic selection of healthy seed and the establishment of regional stations for the producing of improved varieties. No evidence was obtained that the introduction of seed-tubers from cold or more northerly regions was productive of good results.

KRANTZ (F. A.) & BISBY (G. R.). **Relation of mosaic to running-out of Potatoes in Minnesota.**—*Minn. Agric. Exp. Stat. Bull.* 197, 31 pp., 18 figs., 1921.

Tests with varieties of potatoes were begun at Minnesota in 1883, and large numbers of seed-lots were brought together from various parts of North America and Europe for comparison. As early as 1886 'degeneration' or 'running-out' was evident in most, if not all, of the 365 so-called varieties that were being tested. Workers at this time attributed this 'running-out' to 'loss of constitutional vigor in the plant, due to long-continued propagation from the same stock', or to similar vague causes, but the authors believe the explanation lies in the introduction of mosaic (using the term in a broad sense) with some of the tubers brought to the Station for trial. The spread of the disease through all the lots followed, and it was perpetuated by planting each year some of the progeny of the infected plants. References to older English literature indicate that the same or a similar disease occurred in England at least as early as 1782, and was apparently noted even in 1764.

During the last few years more definite study of the 'run-out' condition of potatoes at Minnesota has shown that the trouble is of the mosaic type. As far as is known, leaf roll plays only a subordinate part in producing this condition in Minnesota. The plants showed

mottling of the leaves, and also often crinkling and dropping of the lower leaves. Tests showed that the trouble could be transmitted by inoculation, by rubbing juice from affected plants into stems or leaves of healthy plants, or by grafting stems or tubers of diseased and healthy plants together. The mosaic was transmitted to tomato by grafting. No transmission through the soil was demonstrated, and when healthy tubers were planted in soil containing the roots and tops of mosaic plants, the plants produced appeared healthy. Plants were kept free from the disease in the field by enclosing them in cloth cages, which prevented insect transmission.

Tests of the influence of environment on the development of the trouble were made during six years, since it has been a common belief that run-out plants may be restored to vigour by growing them in a more favourable environment. These tests showed that when tubers from plots badly affected with the mosaic disease were removed to northern Minnesota and planted, improvement did not take place: partially diseased lots of potatoes appeared to recover after a few years, probably through the elimination of the diseased tubers in sorting the seed, under conditions where the disease was not so actively transmitted in the field.

Out of several hundred varieties and strains tested at St. Paul, none showed immunity to the disease.

The use of disease-free stock, and the production of seed from a plot isolated from sources of infection, with early removal of any suspected plants, are recommended as methods of control.

COTTON (A. D.). **The situation with regard to leaf-curl and mosaic in Britain.**—*Royal Hort. Soc. London, Rep. Internat. Potato Conference of 1921*, pp. 153–166. [Received March, 1922].

Experiments and observations in England and Scotland indicate that the mosaic and leaf roll types of diseases (causing the so-called 'deterioration' of potatoes) are transmitted by aphids. In Scotland the spread is slight, on account of the milder or later attack of aphids than in many parts of England. Both diseases are more abundant in the warmer and drier parts of the country, where aphid attacks are more severe.

Plants affected with leaf curl (leaf roll) were found to give from 21 to 64 per cent. less yield than healthy plants. Mosaic apparently did not cause quite as much reduction in the yield. Difference in varietal susceptibility to these diseases are recorded, lists of susceptible varieties being given, and Great Scot being noted as undoubtedly highly resistant.

A number of tests and observations with various varieties in several parts of England, Scotland, and Wales are recorded. Some of the observations in Scotland are of interest as showing that leaf curl, if introduced into certain areas, will persist from year to year so long as seed from the affected crop is used, but that there is little tendency for the disease to spread. In other words, the conditions in these areas are not unfavourable to the disease, but only to the aphids. The value of immature seed may lie in the avoidance of aphid-carried infection merely through early lifting. Further research on the prevalence of aphids in different parts of the country, and on the influence of meteorological and soil conditions

and abundance of alternative food plants on these insects is advocated.

Suggestions to growers in avoiding these troubles are given, and include isolation of seed plots, rogning, and in the use of seed from plants free from the disease.

In the discussion of the paper (pp. 166–168) M. É. Foëx reported added evidence obtained in co-operation with Dr. Quanjer that leaf roll plants always showed phloem-necrosis, while plants suffering from mosaic, crinkle, &c., had none. M. Foëx found that the necrosis usually appeared first in the angles of the cell-walls, and was a process of pectic degeneration, which became arrested probably through the formation of lignin and suberin. The specimens that he selected were from plants with leaf roll or one or other of the other diseases, as well as from healthy plants, and a piece of the petiole was submitted to Dr. Quanjer without informing him of the source. The latter's diagnosis of leaf roll from the histological symptoms in the phloem was in every case correct, all the other specimens being correctly pronounced free from leaf roll.

Ducomet (V.). **À propos des semis de Pommes de terre.** [On raising Potatoes from seed.]—*Journ. Soc. Nat. Hort. de France*, Sér. 4, xxii, pp. 126–131, 1921.

Wishing to test the efficacy in checking degeneration of raising potatoes from seed, as opposed to vegetative propagation, the writer undertook a series of experiments of which the present paper is a preliminary record.

The practice of raising from seed is by no means so complicated as it is usually represented. Without any special precautions 22 kg. per 10 sq. metres were obtained from seed. It is also not necessary to wait until the berry is ripe before gathering it, since the seed can equally well be extracted when the berry is under half its normal size. In variability and vigour the green seed is not inferior to the ripe. This was confirmed by experiments with Marvel of America and Czarina. An important factor, which is frequently overlooked, is the choice of the mother-plant. Here, as elsewhere, bud variation is partially hereditary.

The term 'regeneration' requires some elucidation. It comprises two distinct conceptions, retention and improvement: retention of a type in its varietal characters (qualitative conception), and improvement of that type as regards productivity, vitality, &c. (quantitative conception). Considering first the former it is evident that without at least partial stability of racial attributes, there can be no regeneration. Either these attributes are transmitted to all the descendants (total heredity), or they persist integrally in some of the descendants only (partial heredity). The conflicting opinions of experimentalists on the subject of regeneration are due primarily to the natural diversity of the varieties with which they worked, their constitution (pure or hybrid races), and their stability or polymorphism when propagated.

By way of illustration, one of the writer's own experiments is recorded. Seed plots of Marvel of America were sown for several years in succession. In 1918, 500 plants were grown from the seed of a single inflorescence. The following characteristics were noted:

height very variable, from 0·25 m. to 1 m. and more; habit erect or drooping; leaves pale or very dark green, heart often red; leaflets very tenuous or thick, hard, brittle, covered with bristles or almost smooth; plants precocious or very late, bearing sometimes many and sometimes few stolons; colour of tubers ranging from red to white, that of flesh from pure white to yellow, with frequent production of anthocyan; shape very variable, sometimes spherical, often elongated, the ratio of length to breadth sometimes reaching 2·5. Not one of the progeny was identical with the mother-plant. It is interesting to note that five plants showed distinct evidences of dimorphism or polymorphism, red or variegated tubers being associated with unpigmented. These tubers, planted in 1919, gave rise to plants differing in habit, foliage, flower, and precocity, as well as in the shape and colour of the tubers and in resistance to *Phytophthora*, so that variation may continue in subsequent years, even when the plants are propagated asexually.

The writer's conclusions are that reproduction from seed results in diversification and usually degradation. The great majority of the plants raised by him from seed were manifestly inferior to the mother-plant, from the morphological point of view (small, irregular tubers, rhizomatous plants), physiologically (leaf roll, crinkle, and dwarfing) and pathologically (susceptibility to *Phytophthora*). A few plants only were found to be superior to the parent in resistance to *Phytophthora*, starch content, and productivity.

DUCOMET (V.). **De la dégénérescence des végétaux multipliés par voie asexuée (en particulier de la Pomme de terre).** [The degeneration of plants multiplied asexually (the Potato in particular).]—*Journ. Soc. Nat. Hort. de France*, Sér. 4, xxii, pp. 255–273, 1921.

The author reviews the literature on degeneration of plants published during the past 150 years, and presents briefly the points of view held by various authorities during that time. Some workers have contended that sexual reproduction and the formation of seeds are necessary to maintain a species of plant in full vigour; others, considering that a number of wild and cultivated plants perpetuate themselves indefinitely without seeds, have considered that degeneration is not a necessary concomitant of asexual propagation. The common association of pathologic symptoms with degeneration has been noted by many workers.

Taking the potato, which is the plant most frequently considered to degenerate after asexual propagation, it is pointed out that the average yield per acre has increased during the past century; if, however, degeneration be considered the change in state of a given variety, it may then be noted that certain varieties have been in existence for 50 to 100 years without degeneration. Various symptoms of disease, particularly of the leaf roll and mosaic types, have been commonly noted as occurring on degenerated potato plants. The writer concludes that degeneration is but a word used to express the external appearance of a physiological or pathological state of the plant; that degeneration is only the consequence of disease or poor adaptation of a plant to its environment; and that, in the potato at least, propagation by asexual means cannot be held to

lead inevitably to degeneration of a variety. It is true that new varieties can be produced by sexual reproduction, some of which may be superior to the parents, but replacement of a variety by another is not renovation in the proper sense of the word.

SALAMAN (R. N.). **Degeneration of Potatoes.**—*Royal Hort. Soc. London, Rep. Internat. Potato Conference of 1921*, pp. 79–91. [Received March, 1922.]

The author gives an historical sketch of the ideas held by various workers since 1786 as to the nature of degeneration of potatoes, and points out that these workers had all remarked on symptoms that call to mind mosaic or similar troubles. It is pointed out that the vine, banana, sugar-cane, and *Helianthus tuberosus* have long been propagated asexually without 'degeneration'. Furthermore, if degeneration in potatoes is due to exhaustion, all representatives of the variety wherever grown, being of the same age, should degenerate simultaneously, which is conspicuously not the case: degeneration may occur in seedlings, while some varieties have, on the other hand, been in successful cultivation for fifty years. Certain varieties, as Edgecote Purple, Barley Bounty, and others, have shown immunity to 'degeneration' at Barley. If 'degeneration' be due to senility, the egg and pollen cells also should be affected, and seedlings raised from crosses between degenerated plants should also be degenerate: but the author found that such seedlings were similar to those raised from crosses made before the parents became degenerate, although he thinks that occasionally the germ cells may become infected. The conclusion is reached that 'in the opinion of the writer degeneration is but a symptom of a disease, and this disease is probably mosaic . . .'. Immature seed tubers may be preferable because they have escaped infection. It is believed that the plant breeder can solve the problem presented by the so-called degeneration of the potato, by the production of varieties immune to mosaic and similar diseases.

RICHARDS (B. L.). **Pathogenicity of Corticium vagum on the Potato as affected by soil temperature.**—*Journ. Agric. Res.*, xxi, 7, pp. 459–482, 6 pl., 1921.

Potatoes were grown in soil at approximately constant temperatures of 9, 12, 15, 18, 21, 24, 27, and 30 degrees C. Some of the soil was sterilized and inoculated with pure cultures, or with sclerotia from tubers, of the *Rhizoctonia* stage of *Corticium vagum*. In some cases unsterilized soil was similarly inoculated, and plants in uninoculated sterile or non-sterilized soil were used as checks.

The potato plants grew most rapidly during their early stages at 24° C., but 18° C. was found to be the optimum soil temperature for the later stages. At soil temperatures above 24° C. excessive branching, shortened internodes, decreased leaf segmentation, and decreased stem diameter of the plants occurred. The *Rhizoctonia* produced lesions on potato stems at soil temperatures of 9° to 27° C. The fungus caused two types of stem injury: destruction of the primordia of the young shoots before they appeared above ground, and cankering of the cortex of the underground stems. The former injury was confined to temperatures below 21° (above 21° the rapid

growth of shoots, and decreased pathogenic power of the fungus, prevented this injury) with a maximum at about 12° C. The cankers were most serious at 18°, although even at 9° the damage was large. At and above 24° the fungus was of minor importance.

Rhizoctonia attacked the potato stems more vigorously in unsterilized than in steam sterilized soil.

GROVE (W. B.). **Mycological notes. VI.**—*Journ. of Bot.*, lix, pp. 311-315, 1921.

The fungus of chief interest to pathologists mentioned in this part of the 'Notes' is *Placophomopsis heveae* n. g., n. sp. It occurs on the bark of Pará rubber trees, apparently as the cause of a fatal disease, in Uganda. The pycnidia are of the *Phomopsis* type, but more solid, and based on a subiculum or thin stroma somewhat as in *Placosphaeria*. The subiculum and pycnidia are at first completely hidden by the unblackened periderm, between which and the cortex they develop. Later on, the growth of the pycnidia causes a small fragment of the periderm overlying each to be cast off, leaving them exposed but not projecting. At a late stage the pycnidia fall out, leaving little pale depressions. Their walls are very thick, being composed of ten or twelve layers of dense pseudoparenchyma, of which only the outer two or three are dark brown. Both A- and B-spores occur, either separately or, when together, usually with an excess of the former.

GROENEWEGE (J.). **Over de oorsak van rustiness op rubber van Hevea brasiliensis.** [On the origin of rustiness on rubber from *Hevea brasiliensis*.]—*Meded. Algemeen Proefstat. voor den Landbouw*, xi, 19 pp., 3 figs., 1921. [English summary.]

Rustiness in sheet rubber develops usually when freshly rolled sheet is left in a moist place for twenty-four hours or is dried too slowly. It is due to species of Saccharomycetes and *Oidium*, which develop at the expense of the constituents of the serum enclosed in the rubber. The fungi form a layer of the consistency of butter on the sheets when fresh, which falls apart in scales on being stretched after drying. Quebrachite, proteins, and sugars are the nutrients for these organisms present in the serum, the last being of slight importance. Only one of the yeasts isolated, *Torula heveanensis*, was able to assimilate quebrachite. This organism has thick-walled oval cells, 4–6 μ in diameter, and gives circular colonies which assume a light brown tinge in old cultures on rubber-serum agar. *T. heveanensis* is able to assimilate both quebrachite and proteins, whereas the other organisms involved (*Willia javanica*, *Oidium* sp., *Torula* spp., &c.) are entirely dependent on proteins both for their carbon and nitrogen. *Bacterium prodigiosum*, which can also cause rustiness, grows well in a slightly acid medium containing quebrachite and proteins.

Freshly rolled rubber becomes immune to rustiness if kept for several days under water, because under such conditions the nutrient substances of the serum are removed. The water-soluble substances are dissolved out, and the proteins present in the surface layers of the rubber are also brought into solution by tryptic enzymes secreted by a rich bacterial growth which develops in the water,

When the extracting process is performed under sterile conditions, the water-soluble substances (including quebrachite) alone disappear, the proteins being held in the rubber, which maintains its susceptibility to rust. Dry rubber which has been allowed to soak in water again is practically immune against rustiness. Investigations show that this immunity is attributable to a loss of permeability after drying, which greatly hinders the movement of the water-soluble substances and therewith the supply of nutrition to the organisms causing rustiness. The diffusion of the tryptic enzymes secreted by yeasts and the species of *Oidium* is also rendered practically impossible. These changes in permeability are permanent.

STEVENS (H. P.). **Mould prevention.**—*Bull. Rubber Growers' Assoc.*, iv, 3, pp. 132–133, 1922.

Reference has been made in earlier reports by the author to the incidence of mould on smoked sheet rubber and the means of prevention. The remedial measures hitherto adopted were not altogether satisfactory, and a search has been made for a fungicide which would be effective when added to the latex before coagulation, or dusted on the sheet rubber when packed. Experiments have recently been made with a new preservative, sodium silicofluoride, which is cheap, apparently effective, and free from injurious effects on vulcanization. Tests were carried out, using as a control ordinary estate smoked sheet rubber, with sheet sprinkled with sodium silicofluoride, sheet prepared from standardized latex to which sodium silicofluoride had been added in the proportion of 1·8 gm. to 3,000 c.c. latex, and sheet prepared with the addition of 3 gm. sodium silicofluoride to 3,000 c.c. latex, acetic acid in the proportion of 1 : 1,200 being used for coagulation in the last two.

The conditions of transit were favourable to mould growth. The control and the sprinkled sheet were mouldy when unpacked, while the other two showed scarcely a trace of the fungus. Thus the mere sprinkling of the sheet with sodium silicofluoride is ineffectual, but the addition of this preservative to the latex is an excellent preventive of mould, and sheet prepared from latex thus treated gave satisfactory results on vulcanization, the rate of cure being somewhat more rapid than in the control. No difference could be detected in feel or appearance between these two samples and the control, after cleaning the latter. The process is regarded as being still in the experimental stage.

KEUCHENIUS (P. E.). **Die Rindenbräune der Hevea brasiliensis.** [Brown bast of *Hevea brasiliensis.*]—*Centralblatt für Bakt.*, Ab. 2, lv, 1–4, pp. 14–74, 33 figs., 1921.

Brown bast is now the most important and widespread disease of *Hevea* in eastern Asia, but its origin in all probability dates back to the earliest tapping of the tree. Reports commenting on the occurrence of nodules on the trunks have appeared from time to time since 1887, when Cross described the phenomenon from the valley of the Amazon. Petch was the first, in 1905, to record the symptoms in detail. That it was not until the year 1917 that its serious nature was recognized is probably due to the fact that the great areas of rubber planted during the 'boom' about 1910 were

by 1917 at an age in which the incidence of the disease becomes really marked. The average yearly loss from brown bast in a plantation of 18,000 hectares under the author's observation may be estimated at 3 to 5 per cent., and the cost of treatment at about 100,000 Dutch florins per annum, the value of the rubber lost being at least an equal sum. After five and a half years of tapping, 46 per cent. of the trees in another, ten-year-old, plantation were affected. Careless thinning-out has combined with the disease to reduce the yields from older plantations, since good latex yielders were removed as well as diseased trees. This is probably the reason why many of the plantations of twenty years of age and upwards in the Malay Peninsula yield annually only about 500 lb. of rubber per acre. Up to the present, brown bast is known to occur in the Amazon valley, Dutch and British Guiana, Dutch East Indies, India, Ceylon, and the Malay Peninsula, but it will undoubtedly be found wherever *Hevea* is cultivated.

In the diagnosis of the disease attempts have been made by various investigators, for instance, Harmsen, Rands, and Bobilioff, to establish an early recognition by a microscopic examination of the tissues, but the author believes that a sure diagnosis can only be furnished by the external symptoms. These may be briefly described as the drying-up of the latex flow over the whole extent or a part of the tapping-cut, the affected area being frequently succulent and assuming a greyish-brown to sepia discoloration; further, the disease is capable of metastasis. Symptoms visible through the bark elsewhere than at the tapping-cut first appear months later. The formation of woody nodules is far from being a constant symptom.

The disease invariably appears only following a wound, which in practice means that it is the result of tapping, though occasionally untapped trees may develop it as a consequence of accidental injury from animals or implements. The breaking of branches in a storm may also give rise to an attack.

By the process of metastasis brown bast may shift from one area of the bark to another, working upwards to the right and following the right ascending spiral of the latex tubes. In such cases the appearance of the disease at a second tapping-cut situated higher up can be shown to be due to a continuous extension from the area first affected. A similar metastasis frequently occurs when a large branch is cut or torn off, a rapid extension along a band which may be several yards in length taking place from the diseased area lower down. Extension downwards may also occur when, for instance, the base of the stem is injured by wild pig.

The author has frequently observed that metastasis sets in if tapping is continued after the cut is partially affected, and brown bast soon spreads over the entire length of the cut and beyond its margins. This aspect of metastasis appears to have escaped the notice of earlier investigators. Metastasis clearly occurs only when healthy latex vessels are exposed which directly communicate with the diseased ones, and the latex vessels are the channels through which it takes place. An isolation-cut penetrating as far as the cambium is, therefore, an absolute preventive of spread by metastasis, and the writer has successfully employed this method on

many occasions without having had a single failure. Tapping may safely be continued in the healthy bark if the discoloured area is thus isolated in the early stages of the disease. Resting the trees is also an important measure since metastasis will not take place along sound latex tubes unless these are open at the ends and latex is flowing from them.

The author is unable to find any foundation for the theory that high yielding trees are more susceptible to brown bast than the less prolific. A statistical examination of over 900 trees showed that the difference in susceptibility was negligible. The influence of rainfall, on the other hand, is marked, the disease being much more prevalent during the rainy season (January to April). The type of soil is only indirectly connected with the incidence of the disease, in so far as it influences the development of the trees. Luxuriant development, such as occurs on laterite soils, appears to promote the disease, mainly as a result of the exclusion of light. Poorly developed trees growing on clay soil are less liable to attack, as the light is better able to penetrate the relatively sparse foliage of their crowns. Experiments in thinning carried out in 1917 showed that the percentage of disease decreased in proportion to the number of trees removed. The influence of rainfall appears to act both by increasing the soil and atmospheric humidity and by reducing the intensity of radiation owing to the presence of clouds. Numerous observations have convinced the writer that brown bast occurs in a much more virulent form where there is insufficient light and excessive humidity. The area covered is more extensive, the course of the disease more acute, and the depth of penetration in the bark more profound. Pratt's observation ('Brown bast on rubber trees, its cause and spread.'—*Malayan Tin and Rubber Journ.*, vi, 1917) that the incidence of brown bast is higher when the tapping-cuts approach the ground is fully confirmed by the present writer. The percentage of disease is extremely low when the cuts are situated a yard or so above the level of the soil. It is frequently stated that an increase in the number of tapping-cuts results in a corresponding rise in the percentage of disease. The author, however, concludes that there is no correlation between the number of cuts and the frequency of brown bast. The experiments of Rands [see this *Review*, i, 5, p. 139] are not accepted, since his determination of the percentage of attack was based on microscopic symptoms only, and these the author considers unreliable. On the other hand, the position of the cuts in relation to one another seems to be of considerable importance, the system of having two or more cuts one above another causing a marked increase in the disease. The so-called 'change over system' has the opposite effect.

A tangential section through recently affected tissue reveals a yellow or brownish discoloration of the walls or middle lamellae of the medullary ray cells and of the adjacent latex vessels and sieve tubes. Many intercellular spaces are filled with a yellowish-brown substance, sometimes in granules. The lumina of various cells and of the latex vessels and sieve tubes may be filled with a similar substance, which on histological grounds the author agrees with Rands in regarding as wound-gum. The formation of woody

nodules is only a secondary complication developed around groups of primarily diseased elements.

A process of spontaneous healing takes place underneath the diseased layers of the bark, consisting in the formation by the cambium of healthy layers. The affected layers undergo a gradual necrosis, longitudinal fissures arising in the diseased bark which later dries up and is thrown off in the form of irregular scales.

The period of incubation of brown bast is stated to be very brief, ranging, in the cases investigated by the author, from five to eleven days. The author states that he is the only investigator of brown bast who rejects the theory of a physiological origin. He has isolated bacteria from the diseased tissues which develop slowly in culture while similar tests with healthy bark failed to give colonies. He believes these bacteria to be the cause of the disease, and explains the failure of other investigators to secure successful inoculations with the similar organisms isolated by them, by the peculiar difficulties in this disease of establishing conditions favourable to infection. The disease is one affecting the latex vessels and carried in them. The pressure in these vessels is, however, ordinarily high, and even if the organisms could be introduced into the vessels artificially they would not spread. Successful infection could only be expected during periods when there is a negative pressure in the vessels, and this is difficult to secure. Hence the failure of all attempts to reproduce the disease by inoculation is not considered to be sufficient to disprove its parasitic origin.

An important phenomenon which the author thinks cannot be explained by the physiologists is that of metastasis. The fact that brown bast remains stationary when the tree is allowed to rest may be accounted for on physiological grounds as resulting from exhaustion, wound reactions, or assimilatory disturbances; these cannot, however, explain the arrest of metastasis by isolation when tapping is continued outside the isolated area. If a physiological cause were involved, isolation would tend rather to exaggerate than diminish the ill effects, and the resumption of tapping would at once bring about a recurrence of the disease. The only possible explanation of the phenomenon of metastasis in brown bast is that the latex vessels contain either bacteria or enzymes (or a 'contagium vivum fluidum') which are conveyed with the stream of latex set in motion by tapping. An enzymic theory does not account for the influence of light, humidity, and position of the tapping-cut on the incidence of the disease, nor does it explain the presence of bacteria in the affected tissue. The bacterial infection hypothesis is therefore the more probable of the two.

The writer's own view of the origin of brown bast may be summarized as follows: The disease is infectious, and is caused by facultatively parasitic bacteria which are of general occurrence in the soil and atmosphere. Two of these have appeared in the isolations made, and apparently either or both together may produce brown bast. These bacteria are capable of infection only under the influence of a temporary physiological condition, namely, the loss of positive pressure in the latex vessels after tapping or after a wound. They live exclusively in the latex vessels and are not capable of penetrating other portions of the bark. The brown discoloration of

the cells near the latex vessels is a reaction resulting from the arrested functioning and death of the latter. The latex coagulates, so that the disease cannot spread until tapping is resumed, while the bacteria are held in check by the coagulum. When a part of the bark is tapped which is connected with the diseased area, a current of latex, in which a certain number of bacteria are probably conveyed, moves from the affected tissue towards the wound, and this gives rise to metastasis. The first infection probably occurs through the cut ends of the latex vessels, and is favoured by anything that tends to prolong the latex flow and retard coagulation at the cut surface. The influence of light (which accelerates coagulation) and shade and humidity (which delay it) is thus explained. Rain also increases the possibilities of contamination of the tapping-cut.

To test these views, seventy-six trees were selected and, immediately after tapping, the cut was covered with cotton wool, soaked, in alternate trees, in corrosive sublimate and in ditch water. After a month eight of the trees treated with ditch water were attacked by brown bast and only two of the disinfected. The latter infections were probably to be attributed to showers that diluted the disinfectant.

The methods of combating brown bast in common use, viz. stripping, scraping, and scraping combined with an application of hot tar, are discussed, but are considered to be inferior to the system of treatment which the author has introduced on an area of 18,000 hectares under his care. In this method the boundaries of the discoloured area are exactly determined by scraping away the bark almost to the cambium, and the affected part is then completely isolated by cutting a groove about 1 cm. outside the limits of the disease, reaching to the cambium. Tapping may then be resumed below the isolated area or elsewhere. The trees are examined twice a month, and all cases of brown bast are immediately isolated in this manner. After two or three months woody nodules are often formed in the diseased bark, which can be detected by a few cuts with the tapping-knife, and these must be removed. This method requires only half the labour employed in scraping according to the old system.

B[OBILIOFF ?] (W.). **Over den invloed van teer op de regeneratie van den bast bij Hevea brasiliensis.** [On the effect of tar on bast renewal in *Hevea brasiliensis*.]—*Teysmannia*, xxxii, 10, p. 467, 1921.

Harmsen's treatment of brown bast disease with hot tar (see this *Review*, i, 5, p. 140) is based on the assumption that the bast is more rapidly renewed after its application than untreated bast. This question has recently been studied by Steinmann (*Arch. voor Rubbercult.*, v, p. 495, 1921). The favourable effect of the treatment claimed by Harmsen could only be brought about by a stimulation of cambial activity, but detailed researches have proved this to be non-existent. The increased thickness of the bast under the tar is due exclusively to development in the area containing stone-cells. No more latex vessels are found under the tarred surface of the bast than elsewhere. The thickening of the hard bast under

the tar is negligible, and there is no multiplication of the latex-yielding tissue. In short, the treatment with hot tar as at present practised is useless for the purposes claimed.

BALLY (W.). **Over bast regeneratie bij Hevea.** [On bast renewal in *Hevea*.]—*Meded. Proefstat. Malang*, 36, 12 pp., 13 figs., 1922. [From the *Arch. voor Rubbercult.*, vi, 2, Feb., 1922.]

The author's experiments confirmed Gandrup's view (*Arch. voor Rubbercult.*, pp. 465, 549, 1921) that there is no difference in the formation of the latex vessels under tarred and untarred surfaces, and that the application of tar is therefore superfluous. Tar is a good preventive of stripe canker and mouldy rot, but may be satisfactorily replaced by a less expensive disinfectant such as carbolineum. The results of a series of tests show that the application of external remedies produces a stimulation of the phellogen, which does not, however, influence cambial development.

CHIPP (T. F.). **Another 'Wet Rot', and Poria hypobrunnea.**—*The Gardens' Bull., Straits Settlements*, II, 12, pp. 429–432, 1921.

Some strong shoots from the stump of *Spathodea campanulata*, which had been left in the ground to coppice in the Singapore Botanic Gardens, suddenly ceased growth when eight feet high, shed their leaves, and died. The base of these shoots, as well as the crown of the old stump, which was about three feet above ground-level, were found to be pervaded by yellowish-brown lines, similar to those caused by *Poria hypobrunnea*, while the wood of the collar and root laterals was soft and friable. The outer layers of the wood were stained a yellow brown, and the hyphae had collected under the bark to form a dense felt-like ferruginous plate of large size. On other parts of the collar the hyphae had spread over the surface of the bark, forming stout reddish strands, cohering into narrow plates. The fungus had many of the characteristics of *P. hypobrunnea*, but differed widely in its fructifications, which formed a plate 16 by 12 inches in size, exposed by the fallen bark. They are resupinate, 1 mm. thick, corky, of a ferruginous brown surface and texture, rather darker in the older specimens. The pores are medium-sized and irregular, while their setae are stout, sharp-pointed, and 15 to 20 μ long. The pear-shaped, white, darkly opaque, smooth spores, measuring 6 by 4 μ, have a small hyaline mucro. The fungus is related in its general appearance to *Fomes pomaceus* and agrees with the latter except that its spores cannot be called hyaline. The effects of this fungus are somewhat similar also to those caused by *Fomes pseudoferreus* (formerly known as *Poria hypolateritia*), which is quite prevalent in Malaya. The confusion between *P. hypobrunnea* and *F. pseudoferreus* in Malaya is discussed in a note by Mr. G. E. Perry, which is included in the present article. Both attack the roots of *Hevea brasiliensis*, the former especially in Ceylon, where it has been fully described by Petch (*Trop. Agric.* lii, 1). *P. hypobrunnea* has recently been identified in Malaya by Perry on specimens of *Hevea* from Selangor and Perak, and this is believed to be its first definite recognition in the country. Infected stumps and trees examined by Perry showed the characteristic red mycelial strands and plates adpressed to the

surface of the roots. An account of the disease, based on Petch's description, is given by Perry, who considers that its recent recognition should not cause alarm in Malaya, as it has probably been prevalent for some time but not identified.

The author points out that the characters of the disease of *Spathodea campanulata* indicate that other fungi besides the two mentioned above are capable of causing a wet rot of the base of trees similar to the wet rot of rubber, though the present record refers to a tree which, whilst exotic to Malaya, is not a native of the continent from which the Pará rubber-tree was imported.

MEDALLA (M. G.) & REYES (G. M.). **Fiji disease of Sugar-cane.**—*The Philippine Farmer*, vii, 1, pp. 3 and 5, 1921.

The writers refer to the considerable amount of notice recently given to this disease, and state that although it is serious on a number of varieties, alarmist statements as to the losses caused by it are hardly justified; the disease may be minimized or entirely avoided by simple methods, and there should be no occasion for great apprehension in the Philippines. It has been known in Mindoro since about 1916, and in Luzon nearly as long.

The main symptom of the disease is a greater or lesser stunting of affected shoots according to the susceptibility of the variety, the leaves of the affected cane showing a bunchy, broom-like appearance; the younger newly-formed leaves are crumpled, and there is a growth of side shoots from the upper eyes. At a later stage small elongated galls, extending longitudinally along the veins of the leaf, are found. These do not appear on the native canes until quite late in the disease. The writers point out that ratoon crops are more severely affected than the plant cane.

No parasite has ever been isolated in culture from the diseased tissues, but protoplasmic bodies strongly suggestive of protozoon organisms can be observed under the microscope. The exact nature of these bodies has not been established so far, but the disease is known to be infectious, and there is definite evidence that it is transmitted by seed points.

The first step of importance in controlling the disease is to exclude the moving of seed cane and other cane material from affected plantations into disease-free areas. Growers in infected areas should plant only resistant varieties, among which Rose Bamboo, Striped Singapore, and Badila are reported to give good results in Fiji. The disease may also be minimized in affected areas by planting only seed points from disease-free stools, and in this connexion the authors cite a letter from Mr. Pemberton, of Suva, Fiji Islands, to the effect that the disease is now under complete control in Fiji. This result has been obtained by the rigorous selection of seed for planting, free from any outward evidence of the disease. This is done by specially experienced men passing along the rows and cutting seed only from the stools which show absolutely no sign of the disease; if an otherwise vigorous stool shows even a single affected cane, no cutting is taken from it, and it is either entirely removed and sent to the mill to be ground or dug out and burnt. This simple selection of seed from only healthy stools seems to have resulted in an effective control of the disease, but the

writers were informed by independent planters that a brief laxity in the application of this method for a few seasons results in a quick ascendant recurrence of the disease in all of the newly-planted fields.

WILLIAMS (C. B.). **Report on the Froghopper-blight of Sugar-cane in Trinidad.**—*Mem. Dept. Agric., Trinidad and Tobago*, i, 170 pp., 11 pl., 32 figs., 1921.

Section vii of this report deals with the root disease of sugar-cane. There are two apparently distinct groups of fungi attacking cane roots in Trinidad, the *Marasmius* type and the *Odontia-Himantia* type. In the *Marasmius* type the most conspicuous external symptom is the matting of the leaf-sheafs, especially near the base of the stem, by a white mycelium resembling dried paste. The spores are produced on small mushrooms, which vary in size, number of gills, and colour of the stalk according to the species of *Marasmius* concerned. At least two occur in Trinidad, one with white and the other with purplish-black stalks. This mushroom stage is not often found. *Odontia* in its vegetative stage also mats down the basal leaf-sheaths of the cane, but on pulling them apart a feathery fungus is seen containing numerous minute stellate crystals. This form, which is only found in positions hidden from the light, is known also as *Himantia stellifera*. On the outside of sheaths infested by *H. stellifera* is found a closely-felted granular surfaced fungus producing numerous spores. Two very similar species of this type have been described as *Odontia sacchari* and *O. saccharicola*. In the opinion of Nowell, Johnston, and Stevenson the *Odontia* is the fruiting stage of the *Himantia*, and the writer's own experience of the constant close proximity of the two fungi tends to confirm this view.

These fungi are facultative parasites, and when parasitic they grow in the roots and root-stock of the canes, causing the death of the smaller roots and staining the tissue of the larger ones. The symptoms of the disease are arrested development and an appearance of suffering from drought, even in moist weather. The leaves curl inwards at the edges and turn pale. The internodes of the upper part of the cane do not elongate, the leaves remain crowded together, and adventitious roots are thrown out below the matted leaf-sheaths in an attempt to obtain moisture. The infection rarely spreads above ground to any extent inside the cane, and under favourable conditions healthy shoots may be put out by diseased root-stocks. The disease appears to be particularly severe in Trinidad, destroying larger areas than elsewhere.

The conditions determining the extent of parasitism of the fungus are not clearly understood, the amount of visible fungus being no indication of the degree of damage caused. The injury is most conspicuous after abnormal spells of dry weather at an unusual season (from September to November in Trinidad). Susceptibility to the disease, which is known in all the chief sugar-growing districts, is aggravated by previous injury, insufficient nourishment, badly-aerated or water-logged soil, and excessive soil acidity, but the exact influence of these factors is not sufficiently known and needs further detailed investigation.

In section ix of the report the part played by root disease in the causation of the sugar-cane 'blight' which has done so much damage of recent years in Trinidad is discussed. The writer states that there is now no doubt that injury by froghoppers (*Tomaspis saccharina*) is by far the most important immediate cause of blight. The part played by root disease is nevertheless considerable, blighted fields being almost invariably affected by it, and the amount present being more or less proportional to the severity of the blight. But typical blight can exist when froghoppers alone are present, and it is concluded that the weakening effect of the insect results usually in a rapid spread of the root fungi, which are thus secondary parasites, though at times they may, in the end, cause greater injury than that due to the primary parasite—the froghopper.

Elsewhere in the report it is stated that the green muscardine fungus (*Metarrhizium anisopliae*) is probably the most important natural agent in the control of the adult froghopper, but is closely dependent on weather conditions. Attempts to infect cane fields artificially have not given conclusive results. A species of *Empusa* is a secondary controlling agent.

VAN DER BIJL (P. A.). **Notes on some Sugar-cane matters.**—*Journ. Dept. Agric., S. Africa*, ii, 2, pp. 122–128, 5 figs., 1921.

Root disease is caused in Natal and Zululand by the soil fungus known as *Himantia stellifera* or the stellate-crystal fungus. It cements together the basal leaves of the cane, and on opening the stool interwoven white threads of the fungus may be seen in the ground between the roots. By smothering the young buds the fungus lessens the stand in ratoon crops, and also prevents the growth of planted cuttings. The root system becomes impaired and the plants are thus unable to derive the necessary water supply from the soil. *Himantia stellifera* also occurs on 'umthente' grass (*Imperata arundinacea*) and probably on other grasses. It is a weak parasite on cane, and control methods should be directed towards promoting vigorous growth of the plant, conservation of the soil moisture, and aeration of the root system. On no account must cuttings affected by this fungus be used for planting.

'Ring-spot' (*Leptosphaeria sacchari*) and 'eye-spot' (*Helminthosporium sacchari*) are the commonest leaf diseases, being especially favoured by cool, damp atmospheric conditions and localities. A *Phoma* is usually associated with the *Leptosphaeria*, and is stated by the author to constitute a stage in the life-history of the latter. As a rule these diseases are not severe enough to necessitate treatment, but an attempt should be made to secure immunity by means of selection.

As the stalk of the cane is the sugar-containing region, the fungi occurring on or in it should be considered both in their effect on the plant itself and in their effect on the sugar stored up in the cane, whether as causing a loss of this substance or the formation of products which may later cause trouble in the mills. Diseased stalks generally show a reddening of the tissues, and suspicious cases should be avoided for planting. In Natal and Zululand two widely-distributed fungi are responsible for a reddening of the interior of the stalks and an inversion of the stored-up sugar. They

are *Melanconium sacchari*, the 'rind disease' fungus, and *Cephalosporium sacchari*. The former is easily recognizable by the way the spores break through the rind of the cane in long, kinky, black threads or velvety black patches, according to the prevailing moisture conditions. The second fungus has not been observed to fruit on standing cane, but its spores probably form in abundance when infected cane decays. Owing to its long period of growth, sugar-cane is particularly susceptible to drought and other adverse conditions, which weaken the stalks and make them specially liable to attack by fungi. Careful consideration must therefore be given to external influences and conditions of growth in avoiding these diseases. Stalks allowed to over-mature are also less resistant to fungous diseases. The inversion of sucrose or the formation of undesirable disintegration products in the stalk owing to fungous attacks may also have serious consequences. The annual loss of sucrose caused by stalk fungi is a good deal higher than is usually suspected.

Colletotrichum falcatum, the cause of the red rot disease of cane stems, which has been recorded from nearly all other cane-growing countries, has not hitherto been found in this area.

Schizophyllum commune commonly occurs in Zululand on old cane-stalks lying on the ground, but the author has never seen it on standing cane. It has been recorded as a wound parasite of cane in Java and elsewhere.

A constitutional derangement marked by the occurrence in the internodes of strips of spongy tissue or cavities surrounded by spongy tissue is reported, and stated to be similar to a condition recorded in Java as occurring on cane in which growth has been irregular for some reason, such as a set-back followed by rapid development. The cells in the spongy tissue are dead, filled with air, and without sucrose. These spongy stalks are very liable to fungous diseases.

An examination of the anthers and pollen of the Uba and other varieties of cane which have arrowed in South Africa indicates that the failure of attempts at cross-pollination or selfing is due to one or other of the following causes: the anthers appear to have lost the power of opening, and such pollen as they may contain is not liberated; the pollen is remarkably scanty in the anthers; what pollen there is differs from the normal in certain aspects, which suggest sterility, being irregular in shape instead of circular as in normal cane, and devoid of starch. A variety with normal viable pollen must therefore be procured before success in raising cane seedlings can be expected.

HARTER (L. L.), WEIMER (J. L.), & LAURITZEN (J. I.). **The decay of Sweet Potatoes (Ipomoea batatas) produced by different species of Rhizopus.**—*Phytopath.*, xi, 7, pp. 279–284, 1921.

The Yellow Jersey variety of sweet potato was inoculated with the following species of *Rhizopus*:—*R. nigricans* Ehrnb., *R. reflexus* Bain., *R. chinensis* Saito, *R. tritici* Saito, *R. artocarpi* Racib., *R. delemar* (Boid.) Wehm. & Hanz., *R. maydis* Bruderl., *R. nodosus* Namysl., *R. oryzae* Went & Geer., *R. microsporus* v. Tieg., and *R. arrhizus* Fisch. Rot was caused by all the above species except

R. chinensis and *R. microsporus*. 'Pure lines' of the fungi were used for inoculation. The various species of *Rhizopus* can be grouped into high, intermediate, and low temperature forms, thriving best at 30°-40° C., 20°-35° C., and 15°-20° C. respectively. *R. nigricans*, *R. artocarpi*, and *R. microsporus* are mentioned as low temperature forms, *R. maydis* is an intermediate, and *R. chinensis* a high temperature form.

These results show that other species of *Rhizopus* than *R. nigricans* may cause rot of sweet potatoes in storage. Judging from the inoculation experiments, the amount of damage caused by any particular species will depend to some extent on the temperature, the most successful inoculations having been obtained when the potatoes were incubated at the temperature best suited for the growth of the species used.

HARTER, (L. L.) & WEIMER, (J. L.) **A comparison of the pectinase produced by different species of Rhizopus.**—*Journ. Agric. Res.*, xxii, 7, pp. 371-377, 1921.

Recent investigations by the authors [see this *Review*, i, 2, p. 64] showed that *Rhizopus tritici* Saito, an organism parasitic on sweet potatoes, produces a powerful intracellular and extracellular pectinase; further experiments [see last abstract] proved that nine species of *Rhizopus* are parasitic on sweet potato and that the species differ in degree of parasitism, both as regards the percentage of infection and the rapidity of decay. The writers have now carried out a series of experiments to determine whether pectinase is produced by all species of *Rhizopus*, and, if so, to what extent; and whether its production is any indication as to the parasitism of the species. They studied the secretion of pectinase in eleven species [those mentioned in the preceding abstract], all of which were found to produce pectinase and to exude some of it into the culture solution. Under identical conditions, the amount of pectinase varied with the species. Four of those tested (*nigricans*, *microsporus*, *chinensis*, and *artocarpi*) have a comparatively small amount of pectinase in their mycelium, and two of these (*nigricans* and *artocarpi*, both of which are parasitic on the sweet potato) also secrete a relatively small amount into the solution. On the other hand, *chinensis* and *microsporus*, two non-parasitic species, while retaining a small amount of enzyme in the mycelium, secrete a comparatively large quantity into the culture solution. The other species produce relatively large amounts of pectinase, some of which is exuded and some retained, except in *delemar*, where most of the enzyme is given up to the substratum. The activity of the enzyme was measured by the time necessary to cause complete maceration of trial disks of sweet potato. The results do not reveal any simple relation between pectinase production and parasitism under the conditions of the experiments.

MATZ (J.). **The Rhizoctonias of Porto Rico.**—*Journ. Dept. Agric. Porto Rico*, v, 1, pp. 1-31, 28 pls., 1921.

The present paper deals in detail only with the mycelial and sclerotial stages of the species of *Rhizoctonia* referred to below. A *Corticium* stage, however, is mentioned and figured in associa-

tion with *R. microsclerotia* Matz. It is stated to be similar to the *C. vagum* stage of *R. solani*. Cultures were obtained by suspending the hymenium over an agar plate, the fallen basidiospores being located and their germination observed. They gave a mycelium and sclerotia identical with those of *R. microsclerotia*. No sporing stage has been observed in connexion with the other species studied.

The author's list comprises both soil-inhabiting and aerial forms of the genus, but is not intended to be exhaustive, the chief aim being to secure accuracy in determining the species found during a period of about four months. This can only be done by cultural methods, as some of the species seldom, if ever, produced sclerotia on the host plant, and a recognition from the mycelium alone is usually impossible. A surprising case of polymorphism was observed in connexion with a *Rhizoctonia* found on cowpeas which, morphologically, did not differ from *R. microsclerotia* on *Ficus carica* in Florida [Matz. *Phytopath.*, vii, p. 110, 1917] in so far as its characters on the host plant were concerned, but which, when grown in culture on steam-sterilized bean-pods, invariably produced much larger sclerotia, the diameter being about 1 cm. as compared with the usual 0·5 mm. This difference was found to occur constantly on bean-pods, no matter whether mycelium or a small sclerotium was transferred to the tubes. On cornmeal agar, however, in addition to one or two larger ones, small sclerotia generally appeared on the surface of the agar, similar to those of *R. microsclerotia*. In other collections from cowpea the fungus proved to be identical in all respects with the species found on the fig in Florida.

Although no exact estimate can be made, the damage caused by the different species of the genus to economic plants in Porto Rico is quite considerable. They have been obtained from banana, bean, beet, carrot, celery, celeriac, citrus, corn, cowpea, eggplant, hollyhock, lettuce, field pea, pepper, Natal plum (*Carissa grandiflora*), roselle, sugar-cane, tomato, and yautia. Hardly any of the species found were confined to a single host plant. Sugar-cane, cowpea, and bean have at least three species parasitic on them in Porto Rico, besides, on sugar-cane and bean, *R. solani*. Plants producing abundant foliage are more liable to attack during suitable weather conditions, as the density of the shade, by conserving the humidity of the air, favours the growth of the fungus. It is of interest to note that the aerial forms of the genus produce sclerotia much more freely than the underground forms, which are protected from the sun and wind by a layer of soil.

A key to the characters of the following species is given and the latter are fully described, a list of host plants being furnished in each case. *R. microsclerotia* Matz on cowpea, carrot, bean (*Phaseolus* sp.), *Carissa grandiflora*, and hollyhock; *R. macrosclerotia* n. sp. on bean petioles and stems; *R. dimorpha* n. sp. on cowpea and bean; *R. grisea* (*Sclerotium griseum* Steven.) on sugar-cane; *R. solani* Kühn in its mycelial stage on bean-pod, citrus, roselle (*Hibiscus sabdariffa*) seedling, celery, tomato stem, lettuce leaves, sugar-cane roots, banana roots, pea, and other hosts; *R. pallida* n. sp. on sugar-cane roots, roots of pepper (*Capsicum* sp.), and on

young maize seedlings; *R. ferrugena* n. sp. on sugar-cane roots; *R. melongena* n. sp. on eggplant (*Solanum melongena*); *R. alba* n. sp on leaves of *Apium* sp. The last four are not usually found on the aerial parts of plants, attacking chiefly the underground organs.

The illustrations include a number of photomicrographs showing the cultural characters of the species and the appearance of the sclerotia and branching hyphae in culture.

MOESZ (G.). **Mykologiai Közlemények. IV Közlemeny.** [Mycological communications. Fourth communication.]—*Botanikai Közlemények*, xix, 1–6, pp. 44–66, 13 figs., 1921. [German summary.]

In this paper several new species are described, and figures and notes given on various fungi, chiefly Deuteromycetes and smuts.

Phomopsis daucicola Moesz n. sp., on dead carrot-stems, is stated to be probably the conidial stage of *Diaporthe denigrata* Winter, both fungi forming commonly a broadly effused, brown or black stroma on the stems. *Phomopsis denigrata* (Desm.) Trav., although rather closely allied, is considered to be a distinct species, as it does not seem likely that the same *Phomopsis* could occur both on *Daucus* and *Brunella*, and there is a separate *Diaporthe, D. desmazieri* Niessl, on the latter. The writer believes that the hook-shaped conidiophores described by Allescher and Diedicke in the fructifications of *Phomopsis denigrata*, are really the B-spores of the fungus.

Septoria allii Moesz n. sp. differs from both *S. alliicola* Bäumler and *S. ranojevinicii* Bubák. It occurs on the dry leaf-sheaths, chiefly on the veins, of *Allium oleraceum*, and has pycnidia measuring 116 to 180 μ and conidia 16 to 36 by 2 to 3 μ, continuous, curved, and with narrowed ends.

PALM (B. T.). **Een gevaar voor de tabakscultuur in Deli.** [A menace to Tobacco cultivation in Deli.]—*Bull. Deliproefstat. te Medan-Sumatra*, xiv, 9 pp., 1921. [English summary.]

Generally speaking, the diseases affecting tobacco in the two chief tobacco-growing centres of the Dutch East Indies, Deli in Sumatra and the Vorstenlanden in Java, are the same, namely, the bacterial brown rot or 'slime disease' caused by *Bac. solanacearum* E. F. Sm., the wilt disease due to *Phytophthora nicotianae* Breda de Haan, the foot rot (*Sclerotium rolfsii* Sacc.), and the bacterial leaf disease or 'black rust' produced by *Bact. pseudozoogloeae* Honing. In Deli much the most destructive disease is the bacterial brown rot, *Phytophthora* wilt being less important, while in the Vorstenlanden conditions are reversed. *Sclerotium rolfsii* can do much local damage at times in Deli, while the 'black rust' is present every year, but its severity is closely dependent on temperature conditions.

In the Vorstenlanden, increasing damage is also caused by an *Oidium*, and a similar mildew has recently been observed by the writer in Sumatra, on the Karo plateau towards the centre of the island, attacking native-grown tobacco. A number of the fields in this area were seriously affected by mosaic disease, while the leaf

spot caused by *Cercospora nicotianae* Ell. et Everh. and the 'black rust' were also present. The mildew was first detected at a site about 1,500 metres above sea-level, and was later found to be extensively distributed and to occur on several varieties of tobacco similar to those grown in Deli. The attack commences with isolated white patches on the leaf, which gradually extend along the veins. The patches are seldom found on the under side, and only in exceptional cases is the whole surface covered. The diseased leaves frequently turn yellow and dry up prematurely. The lower (older) leaves are first attacked, then the younger ones on the same plant. This preference for the lower leaves would greatly add to the seriousness of the disease in Deli. In some cases observed by the writer on the plateau every leaf of a plant was attacked.

The fungus is a typical member of the Erysiphaceae, the white patches being formed of fine hyphae on which conidia are produced in large numbers. The length of the conidiophores varies between 150 and 210 μ, and their width between 12 and 17 μ; the conidia are oblong-cylindrical, obtusely rounded at both ends, 25-40 × 15-20 μ. It is therefore probably *Erysiphe cichoracearum*, the mildew which does so much damage to tobacco in other countries. Perithecia were not found, so that exact identification was not possible.

In view of the rapidity with which the disease spreads from place to place, constant vigilance will be necessary to check its advance to the coastal plain of Sumatra, in which the Deli plantations are situated. The shortest distance between the affected localities of the central plateau and the nearest tobacco estate is only about fifty kilometres, and there is a considerable movement of agricultural products from the plateau. The adoption of legislative measures to prevent spread is considered impracticable. Treatment is likely to be very difficult; sulphur dusting is the only method tried in the Vorstenlanden that has checked the disease, but the tobacco treated in this way was found unsuitable for fermentation.

HAENSLER (C. M.). **Fungi injurious to paints.**—*Report of the Department of Plant Pathology of the New Jersey Agric. Coll. Exper. Stat. for the year ending June 30, 1920*, pp. 605-607, 1921.

The author gives a progress report, in which he notes that *Aspergillus* spp. and *Penicillium* spp. are sometimes the cause of discoloured painted surfaces, and that *Dematium pullulans*, *Cladosporium* spp., *Phoma* spp., and an unidentified fungus are important in causing discoloration. *Cladosporium* and *Aspergillus* were also found to cause injury to varnished surfaces.

Tests showed that these fungi cannot derive their full nourishment from linseed oil, and evidently utilize the foreign matter on the paint as at least a partial source of nourishment. The damage is greatest in humid and warm atmospheres. Paint made with lithopone was most subject to attack by fungi, and pure white lead carbonate paints next; zinc oxide and mixed paints showed only occasional colonies. Different kinds of wood tested showed that no influence was exerted on the kind or amount of growth when the same paint was applied. The addition of 1 per cent. by weight of

copper sulphate, 4 per cent. of benzol, or 2 per cent. of mercuric chloride, zinc chloride, carbolic acid, or toluene, each failed to prevent growth of the fungi.

SPIERENBURG (DINA). **Een onbekende ziekte in de Iepen.** [An unknown disease of Elms.]—*Tijdschr. over Plantenziekten*, xxvii, 5, pp. 53–60, 1 fig., 1921.

The disease here described is believed to be entirely new to the Netherlands, and was first brought to the notice of the Phytopathological Service in the autumn of 1919. During 1920, further complaints were received from all parts of the country, so that it appears to be already widely distributed. The examination of the diseased wood indicated that in a few cases the attack began in 1917, but, as a rule, the symptoms were confined to the annual rings of 1918, 1919, and 1920.

In the tops of trees in leaf are dry and withered masses of dead leaves and branches in the midst of the living foliage. The branches are dry, wrinkled, and have a singed appearance, the smaller ones being bent at the tip. The buds for the next year's shoots are mostly small and dried up, and the remaining living foliage dry and brittle. Often the green leaves have dry brown edges. Sections through the wood of the branches and trunks reveal a circle of small brown specks occupying one or more of the outermost annual rings. In the thinner twigs the whole thickness of the wood may be marked by these brown specks, which extend to the tip of the twig. Sometimes large areas of the inner wood of thick branches are discoloured by an infiltration issuing from the brown specks of the outer annual rings. The roots, occasionally the trunk, the discoloured rings, and sometimes the pith of diseased trees may also be marked by large brown spots, darker in colour than the specks in the rings. The walls of the wood vessels and of the parenchyma and medullary ray cells are coloured brown.

Of the two varieties of elm principally used for street-planting and other ornamental purposes, *Ulmus monumentalis* and *U. campestris latifolia*, the former is the more susceptible to the disease.

The beetle *Eccoptogaster scolytus* F. was found in many of the diseased trees, except at Oud-Beierland, but the writer thinks that it follows the disease and has nothing to do with the causation of the latter; nor has the cicada, *Typhlociba*, which was found on the leaves and branches. A number of fungi were also isolated from the diseased material, including *Graphium penicillioides*, *Cephalosporium acremonium*, and species of *Fusarium*, *Phoma*, *Botrytis*, *Didymochaeta*, *Verticillium*, and *Pestalozzia*. Inoculations were undertaken with the first two of these fungi, hitherto with negative results. The writer is, indeed, by no means satisfied that the disease is caused by a parasite, being inclined rather to attribute it to physiological disturbances due to excessive drought, severe frost, or defective soil conditions.

Cases of one-year-old trees attacked by the disease are reported from nurseries at Oudenbosch, while an average annual loss of 20 per cent. is estimated in nurseries in another locality, but it is not certain that all these cases can be attributed to the disease in question.

The only instructions for treatment which can be given at present are to cut away the dead branches, applying carbolineum or tar to the wounds, and to refrain from pruning. Trees attacked by beetles should be painted with 30 per cent. carbolineum in May.

WALKER (J. C). **Onion smudge.**—*Journ. Agric. Res.*, XX, 9, pp. 685–722, 6 pl., 10 figs., 1921.

'Smudge' is considered the best common name for the onion disease commonly attributed to *Vermicularia circinans* Berk., a fungus which, the author thinks, is more properly called *Colletotrichum circinans* (Berk.) Voglino. The disease is widely distributed on white varieties of *Allium cepa*, and other varieties also are susceptible. The shallot (*A. ascalonicum*) and leek (*A. porrum*) also are attacked, but it has not been found on garlic (*A. sativum*).

The disease is confined to the scales and neck of the bulb, and occurs only on unpigmented portions of coloured varieties. Smudge reduces the market value of the crop and results in shrinkage in storage and premature sprouting.

The fungus is described in detail. It belongs to a group of species in which the acervuli are formed on a subcuticular basal stroma. It is considered that the connexion with *Cleistothecopsis*, as reported by Stevens and True, is not yet proved. A large number of species of *Colletotrichum* coincide closely with *C. circinans* as to spore measurements and general characters. A comparison was made with *C. fructus* (S. & H.) Sacc., described as causing a fruit rot of apple. *C. circinans* was found capable of rotting apples, but at a slower rate than *C. fructus*. The latter fungus developed on outer scales of onion bulb, but did not penetrate farther. Thus there are differences in pathogenicity between the two species and slight morphologic differences were also found.

The cultural characters of the fungus are described. The conidia are sensitive to desiccation, except that in spore masses a few spores may survive for four months or more. The stromata retain their vitality for at least two years.

The fungus may cause damping-off of onion seedlings, but otherwise does not attack actively growing plants. It invades the dry outer scales as the bulb approaches maturity, and following harvest there is a further gradual invasion of the dormant cells of the fleshy scales. In severe cases the entire bulb may be penetrated. On germination the spores form appressoria, from which an infection tube develops and penetrates the cuticle. After a period of subcuticular development the underlying cell-wall is softened and the fungus penetrates more deeply, causing collapse of the epidermal and subjacent cells. The cuticle does not share in this softening, but remains intact until the acervuli are formed. Infection occurs at or above 10° C., but progress is slow below 20°, and the optimum is about 26°. Conidia are produced abundantly between 20° and 30° C. under moist conditions, and are disseminated chiefly by spattering rain. The disease develops most rapidly in the field under damp soil conditions and soil temperatures of 20° to 30° C. Very hot, dry weather checks its progress. Artificial drying of onions immediately after harvest checks smudge, and

it does not spread from bulb to bulb in storage except under very moist conditions. The fungus overwinters as stromata in the infected scales.

Experiments with spraying and dusting the bulbs and necks of onion plants failed to check the disease. The important control measures are protection of the harvested crop from rain, rapid and thorough curing, and the provision of well-ventilated, cool (33° to 36° F.) storage.

RODWAY (L.). **On Polyporus pulcherrimus.**—*Papers and Proc. Roy. Soc. Tasmania*, 1921, p. 176 [1922].

Polyporus pulcherrimus n. sp. is described. It is commonly found on the trunk of the evergreen beech, rarely on a eucalypt. The fungus is a wound parasite but spreads to the living wood. Though closely related to *P. confluens* it differs from the latter in several important particulars, such as its bright crimson colour, watery consistency, and larger, oblong spores.

Summary of Laws and Regulations in force in Ceylon in respect of plant pests and diseases.—*Dept. of Agric. Ceylon, Bull.* 48, 6 pp. 1921.

Ordinance No. 5 of 1901, 'the insect pest and quarantine ordinance', empowers the Governor in Executive Council to make regulations for preventing the introduction into Ceylon of insect or fungous pests or plant diseases, and for preventing the spread of such pests and diseases in the island. The regulations still in force under this Ordinance which are wholly or partly concerned with fungous diseases are as follows:

The importation of cacao plants from the Dutch East Indian Colonies is prohibited. All such plants may be destroyed without compensation.

The importation of pepper plants (except dried seed for commercial use) from India is prohibited.

The importation of seeds or plants of *Hevea* (any species) is prohibited.

The revised rules regarding disinfection and fumigation include the following: The importation of tea seed from India and of coconuts in husk is prohibited except at the port of Colombo; but husked coco-nuts, and also tea seed from India, if accompanied by a certificate from a scientific officer of the Indian Tea Association or the Imperial Department of Agriculture, stating that the leaf disease called blister blight (*Exobasidium vexans*) does not exist within ten miles of the estate on which the seed was grown, may be exempt from these regulations.

[By a recent regulation (*Ceylon Govt. Gaz.*, No. 7,235, of Dec. 23, 1921) this last exception is cancelled, and the following substituted: No tea seed shall be imported either directly or indirectly from any place in India.]

Ordinance No. 6 of 1907 provides for the destruction of plant pests and the sanitation of plants in the colony. The Governor in Executive Council may proclaim in the Gazette any insects, parasitic plants, and fungi to be pests, and may prescribe measures for prevention, arrest, and eradication of such pests. The Governor

may also appoint a Plant Pests Board consisting of four to seven members to serve for three years in any revenue district. This Board may enforce the carrying out of the measures in regard to proclaimed pests, compensation not being given unless granted by the Governor in Executive Council. The following proclamations dealing with fungous diseases have been issued under this Ordinance, and are still in force:

Coco-nut trees infected by the fungus *Thielaviopsis ethaceticus*, which causes the stem-bleeding disease, are to be treated by cutting out and burning the diseased parts, scorching the wound and applying hot tar.

Hevea fruits infected by the fungus *Phytophthora faberi* must be burnt or buried with lime. The diseased cortex is also to be excised and burnt.

Fallen or dead coco-nut trees attacked by the species of *Phytophthora* causing nut- and leaf-fall must be destroyed by fire, together with all diseased fruits and fallen leaves.

Importation of Pará Rubber plants into Malaya.

By notification No. 1011 of June 11, 1920, amended by notification No. 1531 of Sept. 30, 1921, under section 22 of the Agricultural Pests Ordinance, 1918, Straits Settlements, and by notification No. 3931 of Aug. 26, 1921, under section 21 of the Agricultural Pests Enactment, 1913, Federated Malay States, the importation of any plant of Pará rubber into the Straits Settlements or Federated Malay States from any place outside them is prohibited except with the written permission of the Director of Agriculture, Federated Malay States and Straits Settlements, and subject to the terms and conditions (if any) imposed by him. All species of *Hevea* are covered by these notifications, and the term plant includes the stem, root, leaf, flower, or fruit, and any product or part thereof whatsoever, whether severed or attached.

Decree of the President of the French Republic of March 8, 1921, prohibiting the importation of living plants, fruits, and seeds of the Chestnut, as a guard against Endothia parasitica.—*Journ. officiel de la République française.* [Abs. in *Internat. Rev. Sc. and Prac. of Agric., Rome,* xii, 5, p. 642, 1921.]

Importation into and transport in France of living plants, fruit, and seeds of chestnuts coming directly or indirectly from the Far East is forbidden, and also from countries which have not adopted preventive and control measures against the chestnut-tree disease caused by *Endothia parasitica*.

Importation permits will, however, be issued by the Ministry of Agriculture on conditions determined according to the advice of the consultative committee on epiphytes.